SCIENTIFIC AMERICAN

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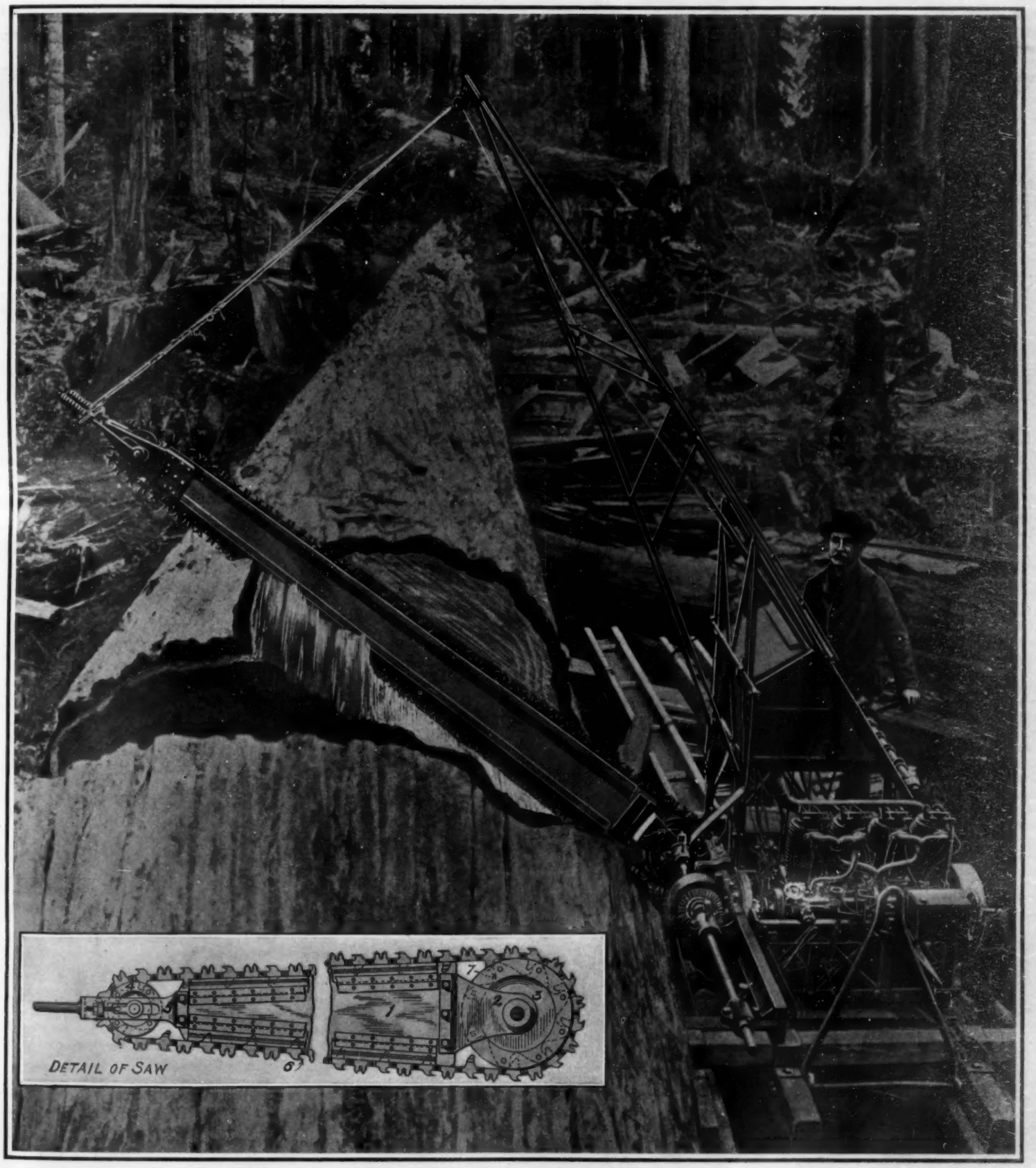
A POPULAR ILLUSTRATED WEEKLY OF THE WORLD'S PROGRESS

Vol. CII.—No. 4. ESTABLISHED 1845.] NEW YORK, JANUARY 22, 1910. [10 CENTS A COPY. $3.00 A YEAR.



The saw is a chain with tooth-links passing over grooved guide wheels at the ends of a frame.

CUTTING A REDWOOD TREE WITH A SAW DRIVEN BY AN ENGINE.—[See page 86.]

SCIENTIFIC AMERICAN

ESTABLISHED 1845

MUNN & CO., Inc., - Editors and Proprietors

Published Weekly at
No. 361 Broadway, New York

CHARLES ALLEN MUNN, *President*
361 Broadway, New York.
FREDERICK CONVERSE BEACH, *Sec'y and Treas.*
361 Broadway, New York.

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One copy, one year, for the United States or Mexico $3.00
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THE SCIENTIFIC AMERICAN PUBLICATIONS.

Scientific American (established 1845) ..... $3.00 a year
Scientific American Supplement (established 1876) ..... 5.00 "
American Homes and Gardens ..... 3.00 "

The combined subscription rates and rates to foreign countries, including Canada, will be furnished upon application.
Remit by postal or express money order, or by bank draft or check.
MUNN & CO., Inc., 361 Broadway, New York.

NEW YORK, SATURDAY, JANUARY 22nd, 1910.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

ADAPTABILITY OF THE GYROSCOPIC CAR TO RAILROAD SERVICE.

BRENNAN and Scherl, each working independently of the other, have recently proved that a car containing a pair of gyroscopes can be run upon a single rail and maintain its stability under varying conditions of eccentric loading, side winds, and curving track. Upon seeing a practical demonstration of this fact, and submitting the car, as the writer recently did, to various severe and successfully-endured tests, it is natural, in the first moment of enthusiasm to predict an immediate and widespread application of the system, or even the eventual abandonment of the present two-rail track and trains in favor of the monorail type. Sober second thought, however, must convince any thoughtful and practical mind that, in spite of the brilliant results of the recent demonstration, the monorail gyroscopic car, in the nature of things, can have only a more or less limited application under present-day conditions. We wish it to be distinctly understood, of course, that any criticisms which follow are in no sense hostile, and are made with a full appreciation of the skill and knowledge, both theoretical and practical, with which the car now being shown in this city has been developed.

THE CAR.—Mainly because of its perfect adaptability to take the curves, whatever the degree of sharpness, with a minimum risk of derailment, the promoters of the system claim that trains of this type will be run at speeds from fifty to one hundred per cent greater than those that are possible on two-rail track. Now if the new system is to compete with the old, the trains must provide at least the same capacity and comfort as the present Pullman trains. It is stated that, in such cars, the weight of the gyroscopes will represent about 8 to 9 per cent of the weight of the car. Structurally, the monorail car must be at least as strong, being supported, like the present type, on two points, namely, the centers of the two trucks. The trucks, however, would be lightened by the reduction of the number of wheels per truck from six to say four, and as the axles would be shortened, it is probable that the weight saved in this way would be about equal to the 8 or 9 per cent represented by the weight of the gyroscope mechanism. Hence, it is not likely that there would be any reduction in the weight of the car as a whole. The gyroscopic mechanism, on the other hand, would be an extra cost and certainly not a very light one. In the very nature of things, it must be most carefully constructed and of the very best material. The motion of the car would undoubtedly be easier. The lateral swaying and shocks incident to the present two-rail system would give place to a very gentle and probably imperceptible rocking motion, due to the controlling action of the gyroscopes. On the curves the riding of the new type would be greatly superior; the sudden jolting of the cars against the outer rail, and the uncomfortable swaying of the passengers in the same direction when the cars are running at high speed would be entirely wanting, except possibly on entering and leaving the curves. Under the two-track system, the car is placed in a favorable position for entering the curve by the gradual elevation of the outside rail for a distance of from 150 to 200 feet before the curve is reached, and also by laying out the first portion of the curve as a spiral with gradually decreasing radius. If some means can be found to throw the gyroscopic car slightly toward the inside of the curve before the latter is reached, it would be advisable to incorporate it.

THE TRACK.—Although the claim which is so frequently made that there would be a simplification of the track and a lessening of its cost is justified by the facts, these advantages would not be so great as might at first be imagined. One line of rails would be dispensed with altogether, it is true; but the remaining rail would in any case have to be made far heavier and stiffer; and if, as is claimed, the speed is to be *doubled*, probably some altogether new system of track would have to be devised. In the first place the concentrated weight on each set of wheels would be exactly doubled; and, since the dynamic shocks upon the track, culverts, bridges, etc., are directly related to the momentum, and the momentum increases directly as the weight and as the square of the velocity, it follows that the dynamic stresses upon the rail, due to lack of perfect alignment, low joints, slight deviations from the true line of the curves, would for double the velocity be just eight times as great with a sixty-ton gyroscopic car as they would be with one of the ordinary type. This could be met by devising a rail with a head several inches in width, and with a depth at least twice that of the present rail. It is doubtful if the present system of cross ties and stone ballast would present sufficient solidity, and some form of permanent masonry roadbed would seem to be a necessity, at least for carrying express trains of the proposed speeds of one hundred miles an hour and over.

In the case of long-span bridges, the concentration of the weight on the center of the floor would call for increased strength in the floor beams; although in the case of deck bridges where the floor is laid upon the top chords, the trusses or plate girders might be brought somewhat closer together.

The cost of maintenance would undoubtedly be considerably reduced, since the labor entailed in keeping two rails to gage and in maintaining the proper superelevation of the outer rail on curves would be entirely eliminated. On the score of safety, provided a suitable form of track were built, the argument is entirely in favor of the gyroscopic car, and especially so on the curves.

It seems to us that if there is a future for the new system, it will be found in the construction of pioneer railways through undeveloped country, and particularly through mountainous and hilly country where the line must of necessity be very circuitous. The self-adjusting qualities of the car enable it to run around curves which would be altogether impossible for a two-track railroad. The monorail track could be located around a hill or bluff, through which a two-track railroad would have to pass with heavy and expensive excavation. Moreover, for this class of railroad a much lighter car would be practicable and extremely high speeds would not be demanded. This decrease in weight and speed would mean a great reduction in first cost and subsequent cost of maintenance of the system. If the new type should demonstrate in service of this kind its commercial practicability, it is quite conceivable that it would be gradually applied to the more important lines of travel, and eventually to the main trunk roads.

IMPORTANT INVESTIGATIONS REGARDING THE PROPULSION OF SHIPS.

IMPORTANT investigations, marking a new era in the study of the propulsion of ships, are about to be undertaken by the Naval Architecture Department of the Massachusetts Institute of Technology, under the direction of Prof. Cecil H. Peabody, the head of the department, and a corps of assistants and associates.

Already a navigable forty-foot model is in process of construction, funds for the maintenance of this work being provided by a friend of the department. In order that the investigations may be of a practical nature, directly connected with the actual conditions of ship propulsion, the model is being patterned after the U. S. S. "Manning," and will be on a one-fifth scale. The choice of the "Manning" as a type of ship for the experiments is made because Prof. Peabody, under whose direction the work is to be done, was directly connected with a remarkable series of speed trials on board the ship, which were reported to the Society of Naval Architects and Marine Engineers in 1899.

After the relations between the actual trials of the ship and those of the navigable model have been established, a certain basis of determination will be furnished, by which it will be possible to determine what may be expected of a full-sized ship, before the latter is built. The method which it is proposed using has been tried successfully in Great Britain to some extent, particularly for such types of vessels as the "Mauretania" and "Lusitania."

Messrs. Denny Brothers of Dumbarton, England, have a private model basin in which they have developed new types of ships, and in the case of the Japanese vessel, the "Otaki," which was built by this firm, just such a navigable model was used to determine the capacity and power of the novel combination of reciprocating engines and low-pressure turbines.

The department has been promised the co-operation of the model basin at the Washington navy yard, and preliminary tests are to be made there very soon on a twenty-foot model with a propeller sixteen inches in diameter.

The problem of propulsion has, according to Prof. Peabody, three distinct parts: first, the resistance of the ship, or the force required to maintain the given speed; second, the power applied to and delivered by the propeller; and third, the effectiveness of the combination of propeller and ship. From necessity and choice the propeller is placed at the stern of the ship, where it can take advantage of the wake, but where it also disturbs the natural flow of water, and consequently increases the resistance considerably above what the pull on a tow rope would be. This combined effect is exceedingly complex and obscure, and consequently has given rise to more difficulty than any other problem connected with the propulsion of ships. This is the particular problem which has been chosen for investigation by aid of the navigable model.

The model is building at the yard of Stearns & McKay at Marblehead, and the propulsion machinery has been already designed. It will consist of a gasoline-electric generating set and a motor geared for experiment work, so that conditions may be controlled over a wide range, and the measurements of power may be simple and accurate. The machinery can also be easily transferred to other hulls as the work progresses.

Upon the completion of experiments with the model built and engined to correspond with the prototype, various forms and locations of propellers will be experimented upon, including twin and triple-screw propellers, especially of the type used at present with marine turbines. The form of the hull will then be changed so far as may be without rebuilding, and the hulls of various forms of ships will be built to extend the range of the experiments.

Another important problem to be undertaken will be the steering and maneuvering, including practical work in rough and stormy seas. As this field has received but little attention in the past, much new and valuable information will be acquired.

This proposed method of investigation has the considerable advantage that a proposed design may be tried on a small and inexpensive scale simulating all the conditions of actual service, including the performance of the ship under adverse weather conditions. After satisfactory conditions have been attained by use of the model, the dimensions and conditions can be determined for the full-sized ship by the theory of mechanical similitude. The fact that this theory leads to the assignment of somewhat higher power to the ship than may be needed gives the designer a margin that may be taken advantage of, but which can be controlled by the preliminary experiments with a full-sized ship for a prototype.

The equipment will be used during the coming spring and summer by Prof. Peabody and his colleagues for original research. It is confidently expected that results will be obtained which will clear up certain obscure places in the theoretical work and design of the students of the department. The training received by the experimenters in the use of the equipment will thus form a part of the laboratory equipment of the department.

In photographic practice it is necessary to regard as capable of affecting a photographic plate all substances which, at the maximum temperature and humidity occurring in practice, produce hydrogen peroxide with sufficient rapidity to cause a perceptible deposit of silver on a plate exposed to their influence during one week. It is well known that most oxidizing agents produce hydrogen dioxide from gaseous oxygen in the presence of moisture. Aluminium, magnesium, and zinc, even at distances of 1/10 and 1/5 inch from the plate, produce a perceptible reduction of silver in two days. Consequently these metals should not be employed in the construction of cameras or plate holders, unless they are very thoroughly lacquered. A piece of newspaper, which has lain in the sun five minutes, affects a plate within 24 hours sufficiently to cause blackening on development. The action of hydrogen dioxide in increasing quantities on photographic emulsions is represented by a curve similar to that which represents the action of light. Paper treated with potassium permanganate affords a complete protection against the action of hydrogen dioxide, as the dioxide is decomposed by the manganese oxide which is formed on the paper.

The perennial debate on Martian canals will probably never be settled. Before the British Astronomical Association various more or less well-known astronomers gave their views. Mr. S. A. Saunders exhibited some pictures taken at Mount Wilson by Prof. Hale on which no trace of the canals appeared. Mr. E. W. Maunder, whose attitude toward Martian canals is well known, again attacked the reality of the canals, advancing as evidence the report of M. Antoniadi, who agrees with Maunder that the canals can be explained by the effect on the eye of the patterns of dark spots.

ENGINEERING.

The North German Lloyd liner "Prinz Friedrich Wilhelm" has had an accident to its steering gear.

The N. Y. C. & H. R. R. R. announced early in 1910 that electric motor power will be used as far north as North White Plains. The delay at Wakefield now made necessary by the change from electricity to steam will be done away with.

The State Commission of Highways of New York has asked for an appropriation of $80,000 to be used by the Commission in developing experiments in economical forms of road construction which would be suitable to various weights and classes of traffic.

The Public Service Commission of the State of New York for the First District, will soon open bids for 37.77 miles of rapid transit lines. The sooner work can be begun on these subways the sooner will the terrible congestion be done away with.

A German machine manufacturer has invented a new means of power transmission by the use of steel wire. It is claimed that the system is equal in every way to leather belts, steel bands, chains, etc., and is much cheaper. The wires are thin, and endless.

Sir Wilfrid Laurier, the Premier of the Dominion of Canada, has launched a bill which calls for the expenditure of $16,000,000 for a Canadian navy of 11 ships. The present indications are that it will carry 5 protected cruisers and 6 destroyers, to be built in Canada.

A special Board of Fire Control has been named by the Secretary of the Navy, to look into the question of the value of the military mast which has been installed on battleships, and report whether other masts of the same type should be placed on other vessels of the fleet.

Since introducing the "Pay Within" cars in Philadelphia the number of accidents to persons has decreased 74 per cent. This is attributed to the arrangement of the closed doors and steps, making it impossible for passengers to get on or off when the cars are moving.

We regret to note the death of Dr. Charles B. Dudley, consulting chemist of the Pennsylvania Railroad and president of the American Society for Testing Materials and of the International Society for Testing Materials. His contribution to the railway world was a most important one.

The total length of the new Manhattan bridge connecting the boroughs of Manhattan and Brooklyn is 6,855 feet. The total cost of the bridge, including real estate, is $15,833,600. The weight of the cables is 6,300 tons. There is provision for four trolley and four elevated tracks, one 35-foot roadway, and two 11-foot promenades.

During the remainder of the winter season vessels of the Cunard Line will steam directly to Fishguard, omitting the call at Queenstown. Since inaugurating this new port of call more than 2,000 passengers have made use of the facilities which have been provided, and have expressed themselves as being well pleased with the saving of time which is effected by cutting out the trip to Liverpool.

Bids are being asked for the seats and frames of the Stoney gate valves to be embedded in the masonry of the twin locks at Pedro Miguel, and the upper twin locks and the spillway at Gatun, on the Panama Canal. Each valve is designed to operate in a well traveling on two roller train bearings with a span of ten feet from center to center, fastened to the down-stream face of the wall casing. Each valve closes an opening 8 feet wide by 18 feet high.

The delay of passenger trains is often caused by a too slow method of admitting the passengers to the trains when the train platform is often crowded. Where tickets have to be examined, and passengers admitted one by one, there is always more or less delay. This can be avoided by a second series of gates. The examination of tickets is made at the first gate, which is then opened in ample time prior to the departure of the train. The passengers are then held behind the second gates until the train arrives or is ready to depart, when a number of gates can be thrown open and the passengers can at once proceed to take their trains.

The N. Y. C. R. R. Co. has asked the up-State Public Service Commission to re-open the investigation which led to an order regarding the use of oil-burning locomotives in the Adirondack forests during certain months of the year. The company says that it has complied strictly with the requirements of the Commission, but finds that the oil fuel is much more expensive than coal, while there is a much greater tendency to fuel leakage, necessitating more frequent repair, and seriously impairing the steaming efficiency of the locomotive when in use. The company is prepared to show that the cost of operating in the Adirondack forest preserves will be about double if oil fuel is used continuously.

ELECTRICAL.

The question of using low-tension metal filament lamps is receiving considerable attention abroad. Transformers are being made for this particular purpose, which are fitted with interrupters, so that they may be used on direct current lines. It has been suggested to fit each lamp with a transformer. The filament of the lamp could be a closed circuit, forming the secondary of the transformer.

A simple method of clarifying the air of a room has recently been suggested. It consists of an electric fan or ventilator, which is operated in a cylinder, and from a reservoir above the fan a liquid is allowed to drop on the fan blades. This is thrown out against the cylinder in a spray, through which the air drawn by the ventilator must pass. This serves to collect the dust from the air. The inventor of this system proposed the use of glycerine or soapsuds, but it has been found that practically as good results can be obtained by the use of water.

A novel method of catching fish was described in a recent issue of the Electrical Review and Western Electrician. A trolley line running between Franklin and Columbus, Ind., skirts the White River for a considerable distance, and it has been discovered that the trolley wire is frequently tapped to furnish current for fishing by electricity. An end of the wire is placed in the water, and the current stuns such fishes as come within its influence, so that they can be taken out with scoop nets. The trolley company and the Indiana Fish and Game Warden are trying to break up this method of fishing.

The following estimate of the value of various electrical industries in the country during 1909 has been published in the Electrical World:

Electrical apparatus	$275,000,000
Electric railways	475,000,000
Central stations	250,000,000
Telephony	250,000,000
Telegraphy	60,000,000
Isolated plant supply	75,000,000
Miscellaneous	50,000,000
Total	$1,435,000,000

The value of aluminium for the field coils of railway motors has been tested in Germany. It is found that the aluminium takes up less space than the copper, although a larger mass of metal is required, because no covering is required. The oxide film on the aluminium provides sufficient insulation and there is no danger of destroying or weakening this insulation by charring as in the case of the cotton covering when the motor is overheated so that there is less danger of short circuits. The principal advantage, however, is in the reduced weight, as the aluminium coils weigh but half as much as the copper coils.

A writer in La Revue Electrique describes the experiments of Miroslaw Kernbaum to determine the effect of ultraviolet light on liquids. He subjected about half an ounce of water to the rays of a quartz mercury vapor lamp, and after about ten hours gas appeared to be forming. At the end of two hundred hours 260 cubic millimeters (0.016 cubic inch) of gas was produced. The gas proved to be hydrogen, while the water showed that it was charged with oxygen. This experiment explains the presence of oxygenated water in snow and rain. It is proposed to use this method for sterilizing liquids, as oxygenated water is an excellent germicide.

Now that aerial navigation is coming to be considered seriously new problems are arising, such as the question of navigation on starless nights or over fog-bound land, when the aeronaut will be unable to find his bearings. It has been proposed by a German inventor that a network of wireless stations be established over the land, each automatically sending out a predetermined signal at regular intervals, which would be received by the air craft, and enable the aeronaut to determine his course. The airships would not be required to carry transmitting apparatus, as a small receiving apparatus would suffice to enable them to avail themselves of this proposed system, and the weight of the receiving device could easily be kept down to a few pounds.

A new method of determining the sag of overhead wires has been suggested by a writer in the Electrotechnische Zeitschrift. The pendulum principle is employed. The sagging wire is set to swinging, and the number of oscillations per minute is noted (the complete motion back and forth being considered, according to European practice, as made up of two oscillations). Letting N stand for the number of oscillations, the sag in centimeters is determined by dividing 447,300 by N^2. To find the sag in inches, divide 176,102 by N^2. Of course, this formula would apply to any distance between poles and any weight or quality of wire, because like the pendulum the period of the oscillation is determined only by the vertical distance between the center of gravity and the ends or pivots of the swinging wire.

SCIENCE.

Prof. E. E. Barnard of Yerkes Observatory has succeeded in obtaining a photograph of Halley's comet which shows a faint slender straight tail. So far as is known, this is the first photograph to show the tail of the present returning comet.

A new estimate of the earth's age has recently been given by Prof. William Morris Davis of Harvard. For the usually accepted one hundred million years he estimates sixty million, based on an examination of the cliffs in Arizona and Utah, where the time taken to deposit the strata can be easily computed.

One objection to glass roofs is that if they are not very steeply inclined, the water of condensation collects on their under surface, and instead of running down along the separating ribs of the panes or plates, and being led off, drips upon persons or objects below, which is inconvenient and may be very expensive. Even where the panes or strips are short, the path to the trough is too long. The increase in length and width of the plates now used makes this difficulty of more and more importance each year. One way of getting around it is, however, similar to that employed in forests and parks to prevent washing away of the hillside paths, namely, making inclined grooves toward the sides; only in this case the grooves are of horseshoe shape, and form a series of parallel corrugations which carry the drops to the ribs which separate the plate; they then follow these without much difficulty down the slant to the trough below. This system may be employed either with glass sheets in which wire is embedded or with plain plates.

We notice in a recent number of the Medical Record a letter from Dr. Robert I. Watkins, New York city, in which he claims the credit of having applied the moving picture to the microscope. He states that as far back as 1897 he demonstrated the machine to a private audience, among whom was the Editor of the SCIENTIFIC AMERICAN. The machine, known as the "micromotoscope," was described in our issue of July 31st, 1897. Later, microscopic moving pictures were exhibited at the Grand Central Palace during the Trained Nurses' and Pure Food Exhibition, the pictures thrown on the screen exhibiting the circulation of the blood in the web of a frog's foot, rotifers in stagnant water, an amœboid leucocyte, typhoid fever germs, and many others. Since that time Dr. Watkins has greatly improved his rough apparatus, and gave a demonstration on June 17th last at Chicago before an audience of five hundred physicians of the National Eclectic Association. We may venture to point out that Dr. Comandon employs not the ordinary mircroscope, but the ultra-microscope.

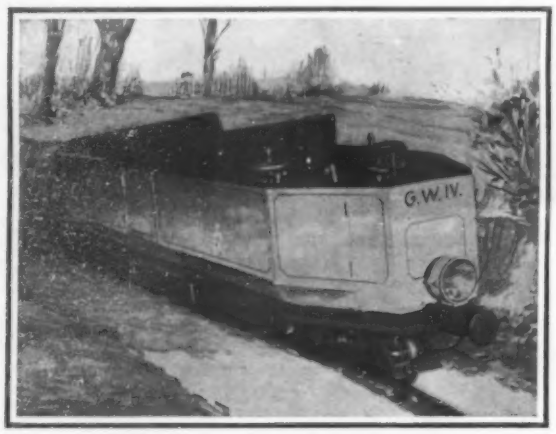
The third paper dealing with the results of the Smithsonian African expedition under Col. Theodore Roosevelt has just been issued by the Smithsonian Institution. It describes a new species of *Octocyon* to which the specific name of *virgatus* is given. This new animal is a small carnivorous mammal closely resembling a fox. It is generally buff in color, and it has been found by Mr. Gerrit Miller of the museum staff to differ slightly from *Octocyon megalotis*, which occurs farther south, especially in color and in the characteristics of its teeth and skull. The octocyon is peculiar to Africa, and is not represented in the United States, but resembles in color the swift or kit fox of the western plains. The skull of this new form closely resembles that of the gray fox of our native fauna. This announcement is of special interest for the reason that comparatively few new forms were expected from this region in Africa, as the territory up to this time explored by the Smithsonian African expedition has been pretty thoroughly examined by British naturalists.

The water bottle for getting water for analysis from selected depths in the ocean is a cylinder of brass, German silver, or other metal which resists the corrosion of sea water, generally about two inches in diameter and twelve or fourteen inches long, with upward-opening valves at the top and bottom, connected together on a central stem. Lugs are cast on the side of the cylinder for conveniently securing it at any point along the length of the line by which it is to be lowered into the sea. During the lowering of the line the valves of the bottle are kept unseated by the passage of the water through the cylinder during its descent; but, when the motion is reversed, the valves seat themselves and are locked by the descent of a small propeller in the framework above the upper valve, which rides idly on a sleeve during the lowering of the bottle, but descends along a screw thread to press the valves upon their seats when the line commences to be hauled up. A specimen of the water at the depth to which the water bottle has descended is thus brought to the surface confined within the bottle, and a series of specimens from different depths may be obtained at one haul by securing a series of water bottles at the required intervals along the sounding line.

THE SCHERL GYROSCOPIC MONORAIL CAR

THE PRINCIPLE OF ITS OPERATION

Within the past few months Mr. Brennan has exhibited at London a car, which runs upon a single rail, and is prevented from falling over to either side by the resistance of two gyroscopes carried on the car. At about the same time, Mr. Scherl, a German capitalist, exhibited in Berlin a similar car. Both cars were of sufficient size to accommodate passengers; both carried their loads successfully; and in each case the gyroscopes maintained the car in a state of equilibrium—and they did this, even when all the load was placed to one side of the car or when the car was running around a curve.



The gyroscopic car inclines automatically to the inside of a curve.

Apparently the inventors worked quite independently of each other; and it is a remarkable fact that in the essential elements for the control of the gyroscopic mechanism, they should have produced machines so broadly identical. The German car, which is now being exhibited in this city, represents the joint labors of Mr. Paul Froelich, the inventor who worked out the theory and data for the design; Mr. Emil Falcke, who designed and constructed the car; and Mr. Scherl, the owner of the patents.

THE GYROSCOPE.—The simple gyroscope consists of a flywheel, so mounted upon a system of bearings that its axis may be tilted in any direction. The peculiar and most interesting behavior of the gyroscope is due to the fact that, when a flywheel so mounted is rotating in a given plane, it resists any effort to change its plane of rotation by tilting the axis on which it is turning. The tendency of the flywheel to maintain its plane of rotation, and its resistance to any force tending to tip it out of that plane, is proportional to its momentum; and since momentum increases directly as the weight, and as the square of the velocity, it is customary to use as small a weight and as high a velocity as possible. Hence, the flywheels used in the Scherl car weigh only 125 pounds each; but they rotate at the enormous speed of 8,000 revolutions per minute. We are all familiar with the gyroscope of the toy shops or the lecture room—the first mounted rotatably in one, the second in two, encompassing rings, with the axes of the rings at right angles to each other, and the flywheel axis in each case capable of universal angular motion. In the accompanying engraving we show a gyroscope mounted as in the Scherl car. The flywheel is carried on a vertical axis, which is mounted in a gimbal ring. This ring swings on a horizontal axis, in bearings carried on two vertical posts, mounted on a board which, for the present purpose, we will consider to represent the deck of the car. If we change the plane of rotation of the flywheel by pressing down on one side and tilting it over toward *B*, two things will happen: The board will resist the downward pressure on that side and tend to rise, and the flywheel will be suddenly tilted over, as shown, in the direction *D*, in a plane at right angles to the plane in which we have depressed the board.

This tilting of the axis is known as its "precession." If, now, we endeavor to increase the precession by pressing down upon the already tilted axis, the latter will resist very strongly, and there will be developed at the same time a large additional resistance to our depression of the side *B* of the board. It is in this "advancement of the precession," as Brennan calls it (though the precession, because of the vigorous resistance of the flywheel axis, is not actually advanced) that the secret of the successful gyroscopic car lies, as will be evident from the following description of the construction and operation of the Scherl car.

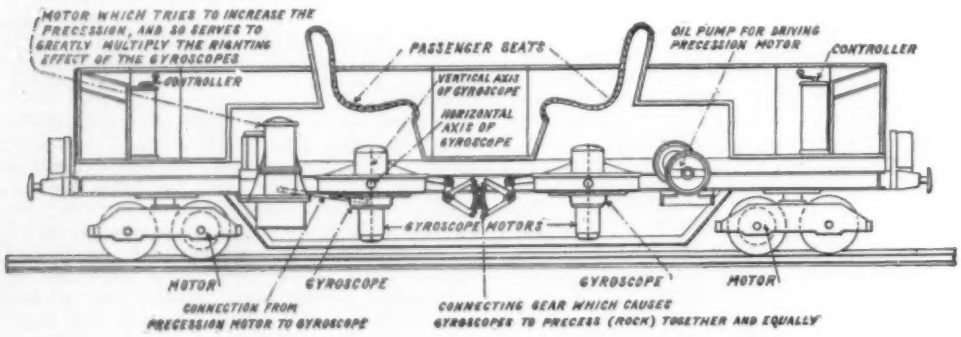
Referring to the engraving showing a longitudinal section, it will be seen that the car, which is 4 feet wide by 18 feet long, is carried on two, 2-wheeled, swiveling trucks, placed centrally below the longitudinal axis of the car. It is driven by two ¾-horse-power motors, one on each truck. At each end is a controller, and a box containing various operating switches. In the center are two seats accommodating four passengers.

Mounted in the car frame underneath the seats are two gyroscopes, one of which rotates clockwise, the other anti-clockwise. The flywheels rotate normally in a horizontal plane on vertical axes. On the lower end of each axis is mounted an electric motor. The axes are journaled in strong, steel, airtight casings, which completely inclose both motors and flywheels; and the gyroscopes run in a perfect vacuum—this to avoid the skin friction of the air, which would retard the speed. The casings are mounted on transverse axes, journaled in the frame of the car, and they are therefore free to rock in a fore-and-aft direction. The clearance between the motor and the casing is so small that the heat of the motors can "jump" the insulating gap and radiate away freely, and "heating up" is thereby avoided. The speed of rotation of the 125-pound flywheels, as we have stated above, is 8,000 per minute.

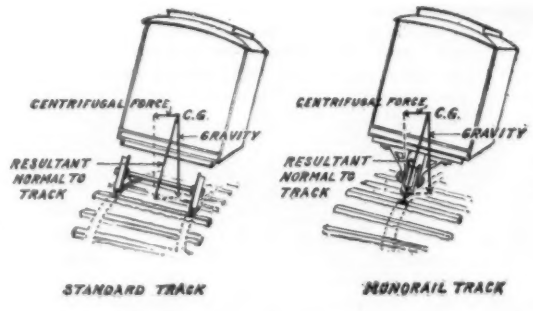
With three men on one side, car tilts to opposite side, restoring equilibrium.

The rocking of the gyroscopes is in opposite directions—if the car is tilted to one side they rock toward each other, and *vice versa;* and to insure simultaneous and equal movement, they are connected together by bell-crank levers and two toothed quadrants, as shown in the drawing. In front of the gyroscopes is an electrically-driven oil pump, for generating hydraulic pressure to drive a precession motor, which is carried at the rear of the gyroscopes. The precession motor consists of a cylinder and piston, controlled by suitable valves. These valves are themselves operated by the rocking movements of the gyroscopes, and the movements of the piston are caused, through suitable mechanical connections, to exert a tilting pull or push, as the case may be, against the gyroscope.

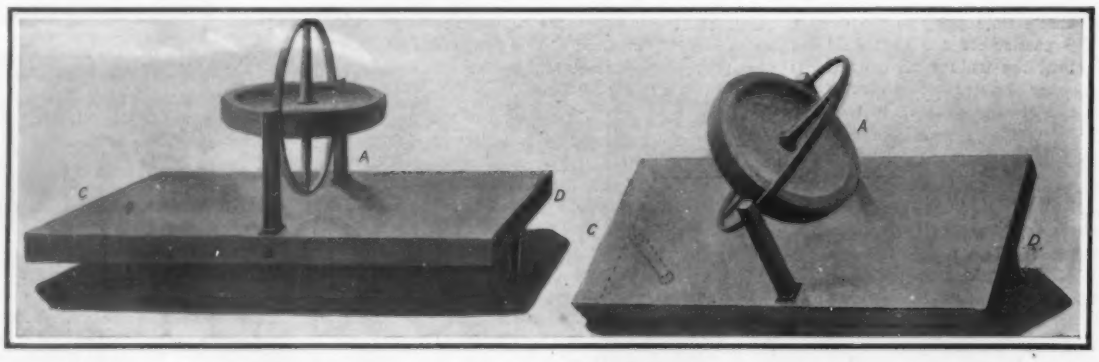
The functioning of this most ingenious mechanism is as follows: When the car tips or tends to tip to one side, there is an immediate resistance tending to right the car, accompanied by a precession (tilting) of the gyroscopes. This "natural" precession actuates the valves of the precession motor, which in turn tilts or attempts to tilt the gyroscope still further on its traverse axis, and so increase the precession. The gyroscope, however, strongly resists, and there is a resulting reaction, transversely to the car, tending to right the latter, so that the righting effect due to the "natural" precession is greatly augmented by the "mechanical" precession attempted by the motor. The motor thus acts as a powerful relay, which automatically and instantly assists in bringing the car to a condition of equilibrium, with the result-



Longitudinal section through Scherl gyrostatic car.



Old and new method of rounding curves.



If the table (representing platform of car) be tilted transversely, the gyroscopic flywheel will tilt fore or aft according to the direction of its rotation, and there will be developed a strong resistance to the movement of the table. This fore-and-aft movement is called the precession.

View showing gyroscopic movements.

THE SCHERL GYROSCOPIC MONORAIL CAR.

ant of all the forces passing through the single rail on which the car runs.

One of our illustrations shows the Scherl car with three people standing on the side step; and it will be noticed that instead of the car inclining toward the loaded side, it actually inclines away from it. This, however, is in agreement with the facts observed in our consideration of the gyroscope, where the pressure on one side was immediately resisted by a counteracting force, causing that side of the gyroscope to rise. In the unloaded condition of the car the gyroscopes were holding it in a state of equilibrium, with the center of gravity vertical above the rail. When the three people stepped upon the car, the center of gravity moved over correspondingly, until it was several inches outside of the rail, causing the car to lean to that side. Immediately, the gyroscopes began to pull the car over to the left, until the center of gravity of the car and the three people was directly above the rail and equilibrium was restored. So sensitive and intelligent, if we may use the term, is the relationship between the gyroscope and its precession motor, that they begin to act immediately upon the disturbance of equilibrium; they exert just the right amount of corrective force; and they become quiescent the moment equilibrium is restored.

Another of our photographic views shows the striking phenomenon of a car running around a curve upon a single rail, and inclining inwardly to the proper degree to maintain its equilibrium. To practical railroad men this is certainly the most attractive feature of the invention; for it would mean the elimination of all the difficult, contradictory and expensive problems connected with the super-elevation of the outside rail on the present two-rail tracks. It is a fact that the car is so intelligent (we cannot help using the term) that, whether the curve be easy or sharp, and whether the car rounds it at ten or seventy-five miles an hour, it will lean inwardly with mathematical certainty to the exact amount required by its speed and the sharpness of the curve.

In the standard system of track, the component of centrifugal force tending to hurl the car over to the outside of the curve, or cause it to "jump" the track, is equalized by elevating the outside rail until the resultant of gravity and centrifugal force falls normally to the track. This condition can only hold true on any given curve for a certain speed. Below that speed a train will grind on the lower rail; above, it will crowd against the outer rail. Not so with the gyroscopic car. As soon as it enters a curve, the pull of centrifugal force is resisted, and the gyroscopes draw the car over to the inside of the rail, until the resultant of all the forces acting upon it passes through the rail.

The gyroscopic car as above described is one of the most brilliant inventions of this or any age. But is it practical, and will it pay? A discussion of this question will be found in our editorial columns.

THE DEATH OF LEON DELAGRANGE.

After making a wonderful new record of 124 miles in 2 hours and 32 minutes on December 30th with a Bleriot monoplane, Leon Delagrange, who, with Henry Farman, was the first aviator to make flights with the crude Voisin biplane in France in the spring of 1907, met his death by a fall with the same monoplane on January 4th, while flying at Bordeaux. Our photograph shows M. Bleriot with Delagrange standing at his left and Le Blanc, another daring pilot of the Bleriot machine, at his right. Behind the three men stands the machine, which is like that Bleriot used in crossing the Channel, and which Delagrange used on the day of the accident. A rather strong wind was blowing, and according to cable reports, when the machine headed into the wind, the right wing suddenly broke and the monoplane fell to the ground. This is the first accident which has occurred owing to the collapse of an aeroplane when in the air. We understand, however, that some time ago a similar accident happened to Latham, but without disastrous results. One wing of his Antoinette monoplane broke off and stood almost at right angles to the other wing, yet by leaning to one side and warping the remaining wing, Latham was able to guide his machine down in circles and bring it safely to the ground. After repairing the wing he attached it in such a

Le Blanc. Bleriot. Delagrange.

BLERIOT AND HIS TWO PILOTS IN FRONT OF HIS NO. 11 TYPE MONOPLANE.

way that when he was up in the air he could pull a cord, and cause the wing to break off as before. He did this, and came down a second time with the wing broken, simply to demonstrate that a broken wing did not necessarily mean disaster. In the Antoinette machine the wings are secured separately to a mast so that the breaking of one does not affect the other. In the Bleriot monoplane the wings are connected together over a tripod, the result being that if one breaks the other collapses, and the machine is sure to be dashed to the ground.

The death of Delagrange will put a damper upon the ardor of some enthusiasts for a time, but it was due to one of those unfortunate accidents which are always liable to occur in the development of a new art. His name will go down to history as one of the martyrs of aerial navigation. He is the fourth aviator to be killed within the past four months, the others being Lefebvre (who plunged to earth in his Wright machine), Capt. Ferber (who struck the ground when making a turn in his Voisin), and the Spanish tailor Fernandez (whose small biplane resembling the Curtiss broke while he was making one of his first flights on December 6th last). All four fatal accidents occurred in France.

A NEW ENGLISH TRIPLANE.

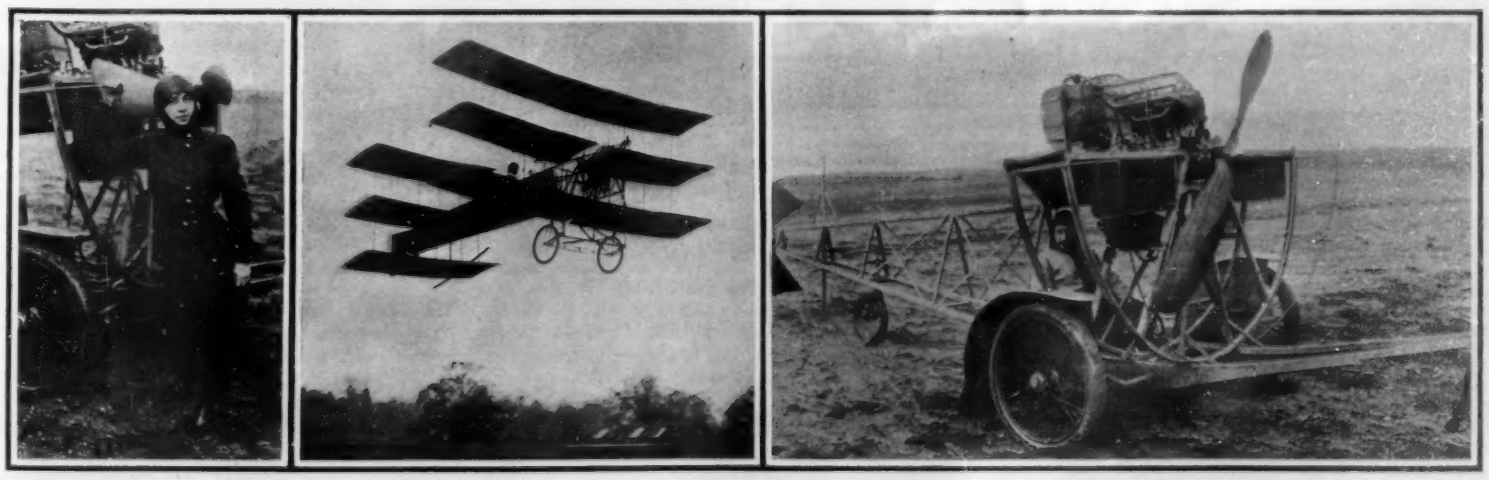
One of our illustrations shows the new triplane of Mr. A. V. Roe. Mr. Roe is one of the most persistent English experimenters. He has been working a long time, and has finally developed a successful machine. His triplane is really a Langley type machine in triplicate, since it has three superposed surfaces forming a tail and attached, like the forward planes, to a triangular body. The motor is mounted in the body at the front end of the machine, and drives a three-bladed propeller mounted upon its crankshaft. The aviator sits in the body about half way between the main planes and the following planes or tail. The machine is mounted upon two wheels at the front and a skid at the rear. It is 23 feet long, and the planes have a spread of 20 feet and 320 square feet of supporting surface. They are set at an angle of five degrees. The forward planes are 20 feet by 3 feet 7 inches while the rear planes are 10 feet by 3 feet 7 inches in size. The total weight of the machine originally with a 10 horse-power Jap. motor was but 200 pounds. A larger motor of 20 horse-power has been fitted. The weight has been considerably increased. The body is made of deal wood. It is covered with cotton oil paper backed with muslin. The machine is steered up and down by changing the inclination of the main planes, which are pivoted so they can be turned. There is a vertical rudder at the rear. The machine is steered by working this rudder and at the same time twisting the rear edges of the main planes.

Mr. Roe has done most of his experimenting at Wembley Park, and recently the grounds have been enlarged there, so as to give him more room. He has made a considerable number of short flights in a straight line, and his machine is remarkable for its low power, light weight and small spread.

AVIATORS' COSTUMES AND A MACHINE FOR TEACHING BEGINNERS.

Two of the photographs reproduced on this page give a very good idea of the costumes worn by French aviators and of the dress soon to be adopted in France by the lady operators or aviatresses. The costumes used by the men consist of overalls and jumper and a tight-fitting skull cap completely covering the head. The costume being used by the lady operators consists of a loose blouse and long bloomers extending to the tops of the shoes. A skull cap similar to that used by the men is also worn. At the present time but two ladies have made flights by themselves in aeroplanes in France. These are the Baroness de la Roche, who operates a Voisin biplane, and who recently met with an accident by running into a tree, and Mlle. Marvingt, who is the first woman in the world to have flown a monoplane. She has made several successful flights with a Hanriot machine. A number of other ladies are learning, however, and several aviation clubs have been formed for women. One of the most recently organized of these was formed at Los Angeles, Cal.

Another interesting picture at the bottom of this page shows a novel training machine for accustoming aviators to a monoplane of the Santos Dumont type. This machine consists of a substantial triangular body mounted upon three wheels and terminating in a tail having movable vertical and horizontal surfaces, by which the machine is steered to right and left when running along on the ground, or by which the tail is made to rise a short distance in the air. The two bottom members of the triangular frame are extended forward and meet above a small wheel five or six feet ahead of the main wheels, so that if the machine tips forward when the tail rises, the front wheel keeps it from tipping too far. A four-cylinder water-cooled motor of 40 horse-power is mounted upon a U-shaped frame, and carries a propeller in front on its crankshaft. The would-be aviator sits in a small seat below the motor with the control levers conveniently at hand. The machine is fitted with large wire wheels fitted with large diameter pneumatic tires. With this machine a beginner can travel at very fast speed over the ground and accustom himself to the steering sideways and up and down of a monoplane. The machine should serve a useful purpose in training aviators who intend to fly this type of aeroplane.



French aviatress costume. Roe's triplane in flight. Machine for familiarizing beginners with an aeroplane.

A NEW ENGLISH TRIPLANE AND A FRENCH MACHINE FOR TEACHING NEW AVIATORS.

A POWER-DRIVEN SAW.

The continuously running flexible saw is by no means a novelty to our readers. Its leading principles are embodied in the band saws now in common use. Although effective for sawing lumber, band saws are incapable of cross-cut sawing on large trees in the forest, because the band necessarily runs in two planes. For the purpose of overcoming this objection, Mr. R. L. Muir has perfected a new style of endless cross-cut saw which is flexible in a single plane of motion and which is carried in a frame which, with the idle side of the saw, follows the saw-cut through the log, the frame being sufficiently stiff and rigid to keep the saw in perfect line.

The frame in question, 1, is made of thin steel with grooved edges. Projecting brackets, 2 and 5, are bolted to the ends. In the brackets guide wheels, 3 and 4, with grooved peripheries are journaled. The bracket, 5, has a handle by which the operator controls the saw. An endless chain composed of saw links, 6, is mounted on the guide wheels and runs on the straight edges of the frame. The guide wheels on the frame serve to keep the chain straight during operation. This frame and the toothed chain constitute an endless saw which runs continuously and which makes a single saw-cut in the plane of its motion. The saw, moreover, is adapted to all kinds and styles of sawing for which either circular saws, band saws or mechanically driven reciprocating saws can be used, and for which hand saws are ordinarily employed, the two handled cross-cut saw being a familiar example.

The chain saw is driven by a gasoline or electric motor, the inner guide wheel being geared up with the motor shaft, as indicated in our front page illustration. The motor is carried on a skid, which skid is moved along on ways whenever a new cut is to be made.

Mr. Muir has carried on extensive trials with the saw in the vast redwood belts of Mendocino and Humboldt Counties in California with remarkable success. The most important advantage of his construction is that of the speed. One of his large saws, it is asserted, will cut through a tree having a diameter of some five to seven feet in less than ten minutes. By the old and slow hand process, this same work would consume an hour and a half, with two men wielding the saw. One of the machine saws will accomplish as much as from 25 to 30 expert sawyers, a wonderful saving in time and expense when it is considered that only two or three men are needed to operate a machine. The saws can be run horizontally, vertically, or on an incline. Trees can be sawed within a few inches of the ground—a great saving thus being effected in stump waste. In felling trees of immense size by the slow chopping methods, hundreds of feet of valuable timber are lost by "chippage," because it is often necessary to cut up as high as eight feet above the level of the stump. The mechanical saw described avoids much of this waste.

AN ELECTRIC PERFORATING PEN.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

Though various efforts have been made from time to time to evolve an electrical system of securing an indelible writing record which is complete proof against both forgery and fraud, such devices have proved commercially impracticable. A Parsee inventor, however, Dr. Dinshah P. Ghadiali, has evolved a simple apparatus which is very efficient. It is called the "antiforge" pen, which, as its name implies, is to render forgery impossible. The writing is made up of a series of perforations burned in the paper. The apparatus comprises a small box with a sloping lid, measuring about 20 inches long by some 16 inches wide. The whole of the electrical equipment is carried within the box or desk, the lid of which is glazed, and carries at its upper end a sheet of aluminium. The pen itself is of the ordinary stylographic type.

The requisite current is drawn from a small 5-ampere storage battery, as shown at *A* in one of the illustrations. The battery is connected up in the usual manner to an induction coil, *B*, to which is fitted a small high-speed trembler, capable of adjustment by a thumb-screw, on the outside of the desk. Between the secondary terminals of the coil a small cylindrical condenser, *C*, is placed in order to increase the intensity and "fatness" of the spark.

In an electric system of writing care must be taken to prevent the inside of such letters as *o*, *d*, *e*, and so forth from dropping out, which would result if the outline were continuous. This possibility is obviated by means of the trembler coil, which makes the current rapidly intermittent. At the same time, however, such rapidly succeeding waves of electrical energy rising up to 10,000 volts instantly followed by a drop to zero, impose a severe strain upon the induction coil, and will in time seriously affect it. To guard against such a result the inventor has introduced a novel device, which may be best described as a safety valve to the coil. This is a highly exhausted vacuum tube, *D*, which is also placed between the secondary terminals and which is in parallel with the pen, *E*. This "etheric buffer" or vacuum tube acts as a ballast load upon the coil, and any resistance which may be offered to the passage of the electric current through the pen is taken up thereby, causing it to glow brilliantly. At the same time it also acts as a galvanometer, as before writing the operator simply presses the pen point against the desk, and the resultant glow in the vacuum

Specimen of writing with the electric pen.

tube indicates that the apparatus is working efficiently.

The pen is about the same length as the ordinary fountain pen and its barrel contains a mercury break. The connection with the coil is effected by a short length of flexible wire carried on a spring barrel. By means of the mercury break contained in the barrel the primary circuit is never closed until the pen is held in the normal writing position. Even then the current cannot flow to the point of the pen, because the cone-shaped extremity carrying the metallic writing point is separated from the barrel connection by means of a spring piston. It is only when the pen point is pressed upon the paper, wherein the metallic extremity is pushed inward against the mercury, that the current can flow to the pen point.

To use the pen, the sheet of paper is laid upon the aluminium pad, which on its under side is connected to the secondary terminal of the induction coil by means of a flat spring. When the point is pressed hard against the paper, and the electrical circuit is completed, the resultant spark burns its way directly through the paper, leaving behind a distinct perforation. The size of the hole thus produced can be varied as desired, from a large, coarse perforation to a small, almost invisible, pin prick, by the adjustment of a rheostat, the knob of which projects from the left hand side of the desk.

With the metallic point only the perforated outline of the writing is produced, but it may be desired to secure a legible distinct surface inscription as well. In this case the metallic point is replaced by a small length of graphite—that taken from an ordinary lead pencil acts excellently. Then in writing one secures a visible surface record and when held up to the light a perforated record may also be seen. In order to obviate the necessity of holding the paper to the light to see if the perforating is being efficiently effected, there is a small metallic filament lamp and reflector fitted inside the desk and by pushing a button on the left-hand side the writer can ascertain the results by examining the writing in the light transmitted through the glass desk lid.

By this method of writing it is impossible to produce two signatures exactly alike, even if written by the same person. The reason is that the electric current in its path through the paper selects the line of least resistance, and the perforation is consequently irregular instead of recurring at regular intervals. The best prepared paper contains infinitesimal obstructions, and these the electric spark avoids. The result is that the operator cannot even produce an exact facsimile of his own handwriting, though each is absolutely correct. This peculiarity is a distinct advantage when it is required to sign a number of sheets of a document, a bond and its duplicate, a will and its copy, for instead of signing each sheet separately the papers are simply superimposed and the top sheet written upon. The current will burn its way through the whole mass of papers so that the signature is written simultaneously on each and in perfect duplication. Consequently it is absolutely impossible fraudulently to withdraw one sheet and insert another with a signature, for it is only a matter of counting the number of dots or perforation marks in the signature on each sheet, and that which differs from the rest is obviously spurious. As many as eight sheets can be perforated by the pen at a time.

The "desk" open, showing the coil and accessories.

The inventor using the perforating pen.

AN ELECTRIC PERFORATING PEN.

The Payroll of the Navy.

To provide for the welfare and comfort of the officers and enlisted men of the navy during the fiscal year of 1911, it is going to cost Uncle Sam just $5,767,477. Of this amount over $5,000,000 will be spent to buy food for the 46,499 enlisted men. The Navy Department figures that it costs the government $108 a year to feed each man, or just $9 a month. The payroll of the enlisted men in the navy during 1911 will aggregate nearly $18,000,000. This sum will take care of 41,723 in the general service, 454 men in the insular force, and 1,156 prisoners under sentence by court martial.

About one-fourth of the men serving in the navy today have re-enlisted. Of the 43,333 allowed by law, 11,681 men are estimated as under re-enlistment and entitled to participate in the allowances for re-enlistment and continuous service. These figures do not take into consideration the 3,000 or more apprentices. Based on the men in the service in June last, the average pay of the enlisted men was $35.75 a month.

The perquisites allowed officers in the navy will aggregate nearly three-quarters of a million dollars in 1911. Of this amount, $144,449 will be spent in providing heat and light. The heaviest cost in the allowance granted the naval officers in addition to their pay is in the matter of quarters for those who cannot be accommodated in buildings or houses maintained by the government. The commutation of quarters will aggregate $435,780, while the commutation of rations, figured at 30 cents a day, will reach a total of $165,456.

An Electric Plant Operated by an Air Turbine.

Near Hamburg, Germany, is a small electric establishment concerning which the following interesting details have been published: The installation comprises 400 incandescent lamps and five electric motors, which drive a threshing machine, a hay cutter, a cream separator, and two pumps. The total capacity is 40 kilowatts. The Hercules turbine has a wheel 40 feet in diameter, mounted on top of a steel tower about 100 feet high. The apparatus begins to work as soon as the wind attains a velocity of 10 or 12 feet per second. In this region a wind of this force can be counted on for 10 hours a day, on the average. With a wind of 26 feet per second the power developed is 30 horse-power, or 22 kilowatts. The installation also includes storage batteries and a gasoline motor for use in calms. The turbine operates so satisfactorily that it was unnecessary to use the gasoline motor during a period of 90 consecutive days. The storage battery, of 60 elements, has a total capacity of 495 ampere hours, and furnishes a current of 165 amperes for three hours. The first cost of the establishment, including the gasoline motor, was about $8,000, while the plant which it replaced and which was operated entirely by a gasoline motor, cost only $5,000. On the other hand, the annual cost of operation of the electric plant is only $1,100, while that of the old plant was $1,700.

The work of extending the electric zone of the New York Central Railroad as far as North White Plains is proceeding quite rapidly, and it is expected that by the first day of next year it will be in full operation. The temporary terminus at Wakefield, where steam and electric locomotives are interchanged, will then be abandoned. A new sub-station is being erected at Tuckahoe and another one at White Plains. Each will be equipped with three 1,000-kilowatt rotary converters and nine single-phase transformers of 375 kilowatts capacity.

Correspondence.

A MATHEMATICAL ODDITY.

To the Editor of the SCIENTIFIC AMERICAN:

If your correspondent in the issue of November 27th will study the following figures, he will plainly see that it is impossible to get 35 sets of 3 out of 1-15 so that no two numbers will be in the same set more than once.

1	2	3	1	6	11	1	7	13	1	8	15	1	9	12	1	10	14
4	5	6	2	7	12	2	8	14	2	9	11	2	10	13	2	6	15
7	8	9	3	8	13	3	9	15	3	10	12	3	6	14	3	7	11
10	11	12	4	9	14	4	10	11	4	6	13	4	7	15	4	8	12
13	14	15	5	10	15	5	6	12	5	7	14	5	8	11	5	9	13

Brooklyn, N. Y. JOHN WEHNAU.

LOCALIZING GASOLINE EXPLOSION.

To the Editor of the SCIENTIFIC AMERICAN:

The recent explosion of a gasoline tank on an automobile, and also one in this vicinity of an autoboat, both attended with fatalities, has suggested to my mind a facile means of rendering these explosions harmless. A number of years ago I was reading a description of a powder factory, and one of the means used to minimize danger was in the construction of magazines. In order to localize the effect of explosions, the warehouses and some of the factories were built on the edge of a river. The five sides not abutting on the river were made extraordinarily strong, while the side fronting and opening on the river was made correspondingly weak. As forces seek the avenue of least resistance, the houses so constructed were analagous to a gun barrel, the explosion was localized, and its force expended more or less harmlessly over the face of the stream. How easy then to see a gasoline explosion rendered innocuous to the occupants of a motor vehicle. Simply by making the reservoir analagous to a gun barrel. Constructing the back and barrel of the gasoline reservoir in cylindrical form of boiler plate, say ⅛ inch thick, the rear end, pointing in the clear, toward the rear of the vehicle. The explosion then is similar to that of a rifle or shotgun, and is directed harmlessly away from the occupants. The rear end may have valve seat bearing and be clamped in with a spring to resist ordinary wear, vibration, and pressure, but yielding harmlessly to explosive force. Thus an explosion of gasoline in the reservoir need cost no more than a recharge of that volatile spirit, and the labor of reclamping the rear end. G. O'C. MCMANUS.

Houston, Tex.

CONTINUOUS BISECTION OF A MILE.

To the Editor of the SCIENTIFIC AMERICAN:

We all know that the middle and western portions of this country are laid out in mile-square sections which can be continuously bisected to form homesteads of 160 acres, and then smaller lots, whose size and location can be briefly and accurately described.

The last whole number that we reach by subdivision in this manner in feet is 165, and this would form the sides of a square, whose area would be 100 square rods.

Continuing the bisection of this 165 feet through inches and fractions thereof, we presently reach the length of 30.9375 inches, which approximates to the U. S. military step by 0.0625 inch, an amount inappreciable in actual measurement by pacing. Now this length of pace is that of the standard axe helve measured from the inside of the bit to the end of the handle. It is the length of the average human arm, and reminds one of the South American *vara* of 32 or 34 inches, which also probably had its origin in the length of a pace. Being squared, it will divide evenly. of course, into any of the above-mentioned divisions of land, and the periphery of such square is ¼ inch less than that of the standard wagon bed of the middle west, which is coming more into use as a measure of capacity. If we make a cube of this dimension the contents of four such cubes would project above the sides of such wagon bed 1/10 inch, an amount which would require careful measurement to detect. One such cube, filled with water, would hold close to one cubic foot of water more than the one-half ton of 1,000 pounds, and would divide into the cubic meter 2.06 times.

But a remarkably close approximation to our standard measures of capacity is found in further twice bisecting this length of 30.9375 inches. We find thus a length of 7.73 + inches, which, cubed as before, approaches the capacity of two of our standard liquid gallons within two-thirds of a cubic inch.

These approximations, useful to the military man, the woodman, and the farmer for rough and limited estimate, might be made accurate by proper statutory action, and thus form a connection, as in the metric system, between our measures of length, area, volume, and weight. There is no doubt that the method of continuous bisection is the natural one, deriving the lower denominations from the higher, as we habitually say "half" and "quarter" dollar, "half" and "quarter" hour instead of so many dimes or so many minutes; "half" ton or "half" pound, instead of so many pounds or ounces. Observe, too, that it (continuous bisection) is the method we use in deriving all of our lower measures of volume.

Guthrie, Okla. JOHN M. BISHOP.

SIGHTING A RIFLE.

To the Editor of the SCIENTIFIC AMERICAN:

Every marksman is familiar with the effect of raising or lowering the rear sight on his rifle. Perhaps not so commonly understood is the effect of raising or lowering both front and rear sights simultaneously.

On point-blank range the target, front, and rear sights lie in the same straight line when the gun is correctly pointed. The trajectory of the bullet is a curve, intersecting this straight line in two points, one of which is the center of the target. It therefore follows that if a rifle is correctly sighted for one range, there is another range for which it is equally correct, and it is the purpose of this article to show how these two points may be located at will by correctly arranging the elevation of both front and rear sights.

The most accurate shooting is done with 0.22-caliber rifles at ranges of from 25 to 50 yards; and when once the sights are correctly set for one range, no marksman likes to change them. It may therefore be of interest to know how they may be set for correct work at two ranges which may be a considerable distance apart.

The path of a projectile *in vacuo* is a parabola; and, since air resistance may be neglected for very short ranges and low velocities, the parabola equation will be correct enough for our purposes. The equation is usually stated thus:

$$y = x \tan a - \frac{g x^2}{2 v^2 \cos^2 a}$$

y is the distance from the line of sights to the center of the gun barrel; x, the range; g, the acceleration of gravitation; and a, the angle between the line of sights and the center line of the gun barrel. The relation of those quantities is all shown in exaggerated detail in the diagram.

Since the angle a will be quite small for short ranges, we may replace $\cos^2 a$ with unity, which is practically its equivalent, thus simplifying the equation. This gives us:

$$y = x \tan a - 16.1 \frac{x^2}{v^2}$$

Taking data from a Winchester 0.22 rifle equipped with globe sights and sighted for 75 feet, we have $y = 9/16$ inch $= 0.0468$ feet, $v = 1{,}000$ feet per sec.

Thus: $0.0468 = x \tan a - \frac{16.1\, x^2}{1{,}000^2}$

Reducing to the form $x^2 + \frac{b}{a} x + \frac{c}{a} = 0$ in which the product of the roots equals the third term we have

$$x^2 - \left(\frac{1000^2}{16.1} \tan a\right) x + \frac{1000^2}{16.1} 0.0468 = 0. \qquad (2)$$

Calling the roots x_1 and x_2, $x_1 x_2 = \frac{1{,}000^2}{16.1} 0.0468.$

$x_1 = 75$ feet $\quad 75\, x_2 = \frac{1{,}000^2}{16.1} 0.0468 \quad x_2 = 39$ feet

Thus when one range is 75 feet the other is 39 feet, which is too close to be of any use. We see also that the 75-foot range is on the falling side of the curve, so that a little greater distance will land the bullet below the mark.

To bring x_2 on the farther side of x, it is evidently necessary that y must be increased, or, in other words, both the front and rear sights of the rifle must be elevated.

We will now find the value of y, so that the gun will shoot correctly at both 75 and 150 feet. As before:

$$x^2 - \left(\frac{1000^2}{16.1} \tan a\right) x + \frac{1000^2}{16.1} y = 0. \qquad (3)$$

Taking the product of the roots equal to the third term, $75.150 = \frac{1{,}000^2}{16.1} y$, $y = 0.181$ feet $= 2.17$ inches.

Thus by setting the front sight 2.17 inches above the center of the bore, and elevating the rear sight till the gun shoots correctly at 75 feet, it will be found also correct at 150 feet. Moreover, it may be shown that at no range between 75 and 150 feet will the error be more than 2.4 inches. The angle of elevation of the sights may also be determined from the equation, but it is much easier to get this angle right by means of trial shots, as it is very small and difficult to measure. Its determination is as follows: In equation (3) the sum of the roots equals the coefficient of x with its sign changed. Thus: $75 + 150 = 225 = \frac{1{,}000^2}{16.1} \tan a$

$\tan a = 0.00362 \quad a = 12$ min. 27 sec.

Of course, all the above results are based on the assumption that the velocity is 1,000 feet per second, which is about correct for a 0.22 short cartridge. Below is given a table in which the values of y are worked out for other velocities and ranges.

Air resistance, which causes the projectile to depart from a parabolic path, will have the general effect of causing the tabular values of y to be too low, but this effect is not very noticeable for the short ranges and low velocities which are common in 0.22 caliber marksmanship.

The results are not intended to apply to high-power rifles and long ranges, although the departure of the projectile from a parabolic path does not alter the fact that any rifle may be correctly sighted for any two ranges within its limit.

Velocity in Feet per Second.	Height in inches of front sight above center of gun-barrel for different combinations of ranges in feet.						
	50-75	50-100	50-200	50-300	75-150	75-200	75-300
900	0.895	1.19	2.38	3.58	2.08	3.58	5.38
1000	0.725	0.965	1.93	2.90	1.17	2.90	4.35
1100	0.60	0.80	1.60	2.4	1.80	2.4	3.60
1200	0.506	0.67	1.35	2.01	1.51	2.01	3.02
1300	0.43	0.57	1.14	1.72	1.29	1.72	2.57
1400	0.37	0.49	0.985	1.48	1.11	1.48	2.22
1500	0.32	0.43	0.86	1.29	0.97	1.29	1.94

Warren, O. WILLIAM C. WOODLAND.

The Light of the Firefly.

After referring to the original work of Profs. Langley and Berry and describing accurately their methods of investigation, Dr. H. E. Ives and W. W. Coblentz draw from their own investigations the following very interesting conclusion as to the relative efficiencies of the light of the firefly and that of incandescent electric lamps.

The efficiency of the light of the carbon filament lamp is 0.43 per cent; in other words, of all the energy consumed only 0.43 per cent is converted into light. The tungsten lamp has an efficiency of 1.3 per cent, and the mercury arc 3.8 per cent. The efficiency of the light of the firefly is 96.5 per cent. Making the comparison in another form: the carbon filament lamp has an efficiency of 83 watts per mean hemispherical candle; the tungsten lamp 1.6 per candle, and the metallic arc 0.55 watt per candle. In comparison with these the firefly has an efficiency of 0.02 watts per candle.

The Current Supplement.

The current SUPPLEMENT, No. 1,777, opens with an interesting article by the English correspondent of the SCIENTIFIC AMERICAN on the Madras Harbor Works, which include a north breakwater arm 1,500 feet long to protect a new entrance. E. A. Allcut writes on producer-gas for engine fuel. While means of illumination have been developing, and the organized systems of distribution have ramified throughout the community, there has been another and very different development going on, viz., the growth of a branch of the science of optics, which deals with the measurements of luminous values, and which has been embodied in what is now called illuminating engineering. Dr. A. D. Rockwell writes on the incandescent and arc light in medicine. "Cartagena de Indias," as it was termed by the ancient governments, and now spoken of in Colombia as "The Heroic City," has more of the tragic and melodramatic in her history than any other town on the western continent. The story of this community is told by Isaac A. Manning. The year 1909 marked the three hundredth anniversary of the invention of the telescope; the occasion is fittingly described by Prof. J. L. E. Dreyer in an excellent article on the history of the invention of the telescope. Mr. Charles Richards Dodge contributes an article on forest destruction by insects *versus* forest fires.

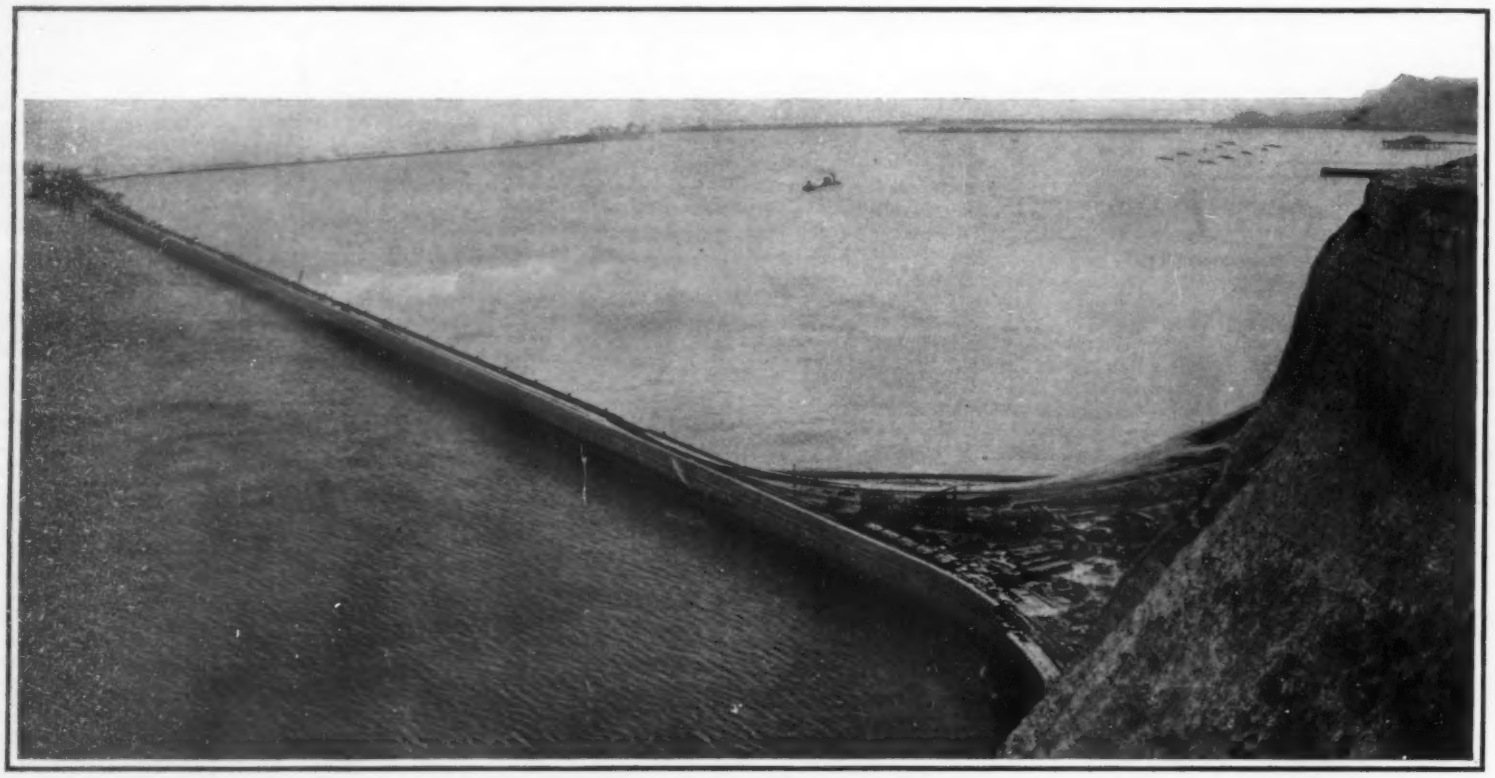
The Battle River Viaduct of the Grand Trunk Pacific Railway, 675½ miles west of Winnipeg, completed in December, 1908, is a steel-plate girder viaduct 2,272 feet long between abutments and 184 feet high from base of rail to low water, or about 139 feet average height above ground. It comprises a 150-foot deck truss span crossing the main part of the river channel, one 70-foot plate girder span and fifty-one 50-foot plate girder spans, resting on twenty-six steel towers. Thus the tower spans are of equal length with the intermediate spans, i. e., 50 feet. The substructure is of concrete, the two river piers and most of the land footings being founded on piles.

THE NEW NAVAL HARBOR AT DOVER

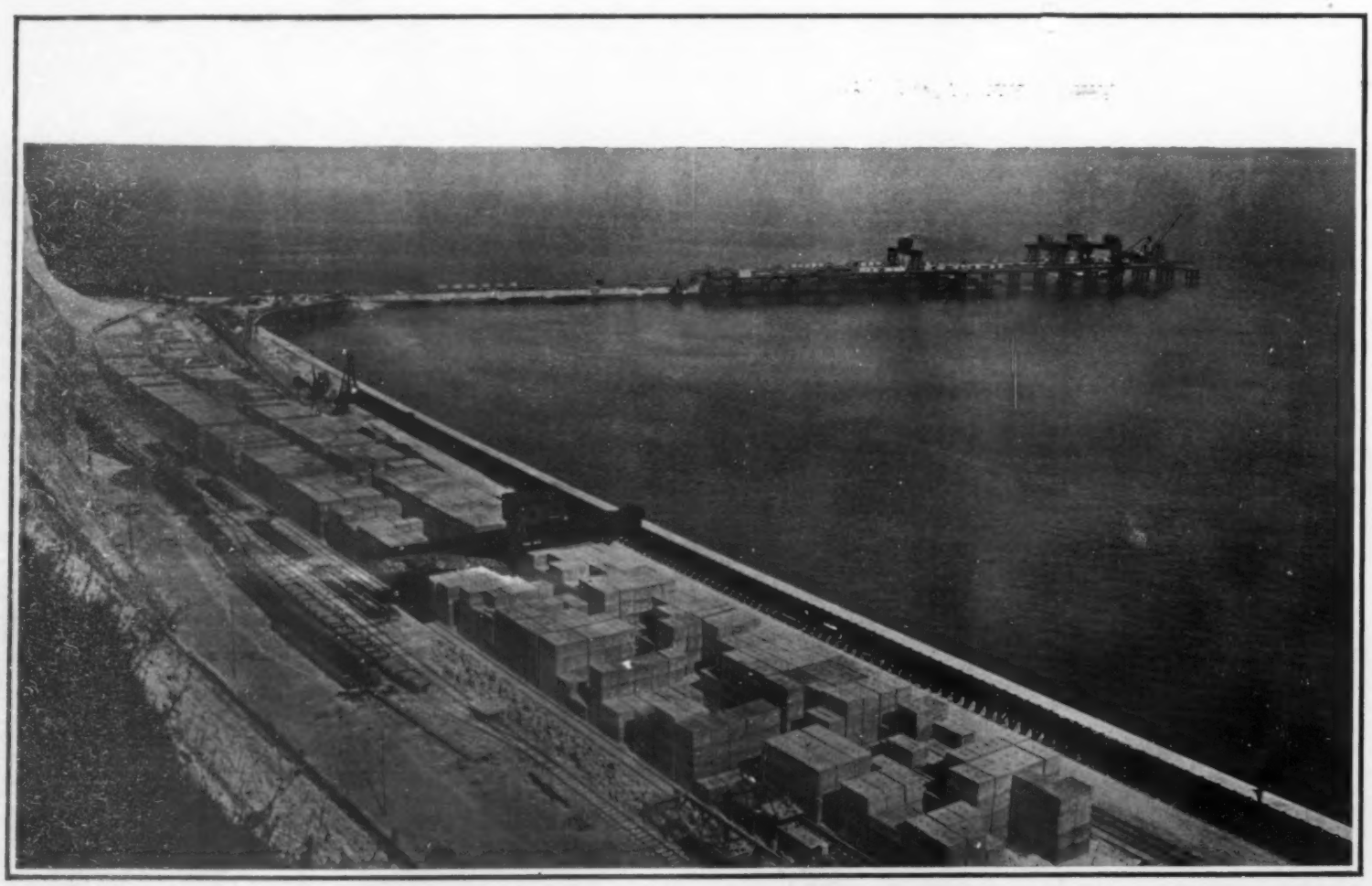
BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN

The harbor facilities of the British Admiralty have been greatly extended by the recent completion of the new and extensive works at Dover at a cost of some $20,000,000. Dover is a point of considerable strategical importance, and the necessity of some refuge for war vessels in its vicinity was advocated some hundreds of years ago. Unfortunately, however, its geographical situation is such that it is exposed to all seas between extreme east and extreme west, the full fury of which appears to be concentrated, or at any rate is experienced, thereat. There was no convenient headland or other natural barriers of which advantage could be taken, so that to convert the port into a harbor of refuge, easily accessible in all weathers, and which would be completely safe, necessitated elaborate development works.

It was in 1895 that the government decided to convert the port into a national harbor, with a low-water area of 610 acres, by the construction of a protection arm on the eastern side of the slight bay, projecting 2,942 feet into the sea, the reclamation of 3,900 feet of foreshore at the base of the cliffs, the extension of the existing Admiralty pier used by the vessels engaged in the cross-channel traffic with France, and an island breakwater between the two extremities of the land arms, 4,212 feet in length. The general design of the works may be gathered from the accompanying plan,



General view of the harbor from the east.



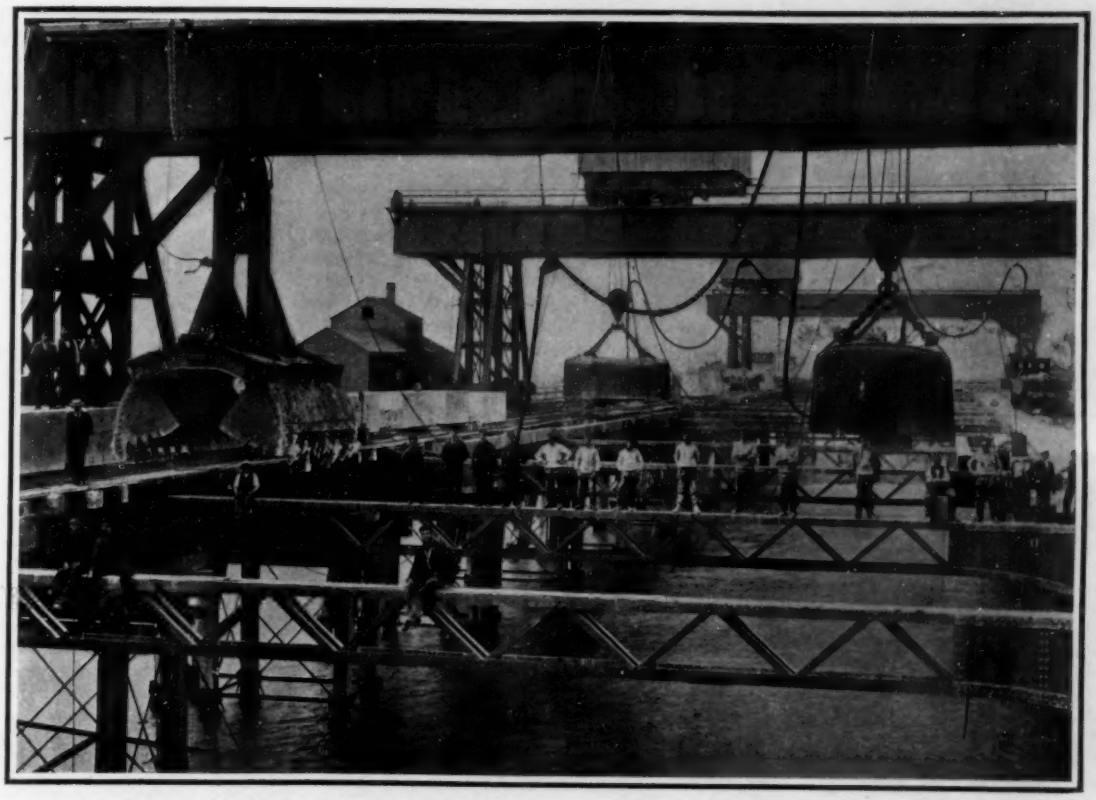
Reclaimed area in foreground of 22 acres where blocks were prepared and stacked and work is beginning at eastern arm.

THE NEW NAVAL HARBOR AT DOVER.

in which the new construction is indicated by the sections indicated in full black. It will thus be seen that an aggregate length of 11,154 feet, or over two miles of breakwater, has been constructed. Access to the anchorage is secured by a gap between the western extremity of the sea arm and the Admiralty pier, 740 feet in width, and on the eastern side by another gap, 650 feet in width. By this means the harbor can be entered in any weather, tidal circulation is promoted, and silting up within the inclosed area prevented. The arrangements provide for a water depth at the entrances ranging from 40 to 43 feet at low spring tides; and as these tides rise nearly 19 feet, it will be seen that at high spring tides the water depth is about 60 feet. Within the harbor itself a water depth at low tide up to 40 feet is available, thus meeting the requirements of the largest war vessels. The contract for the undertaking was placed in 1897 with Messrs. S. Pearson & Sons, Ltd., of London, to whose courtesy we are indebted for the accompanying illustrations.

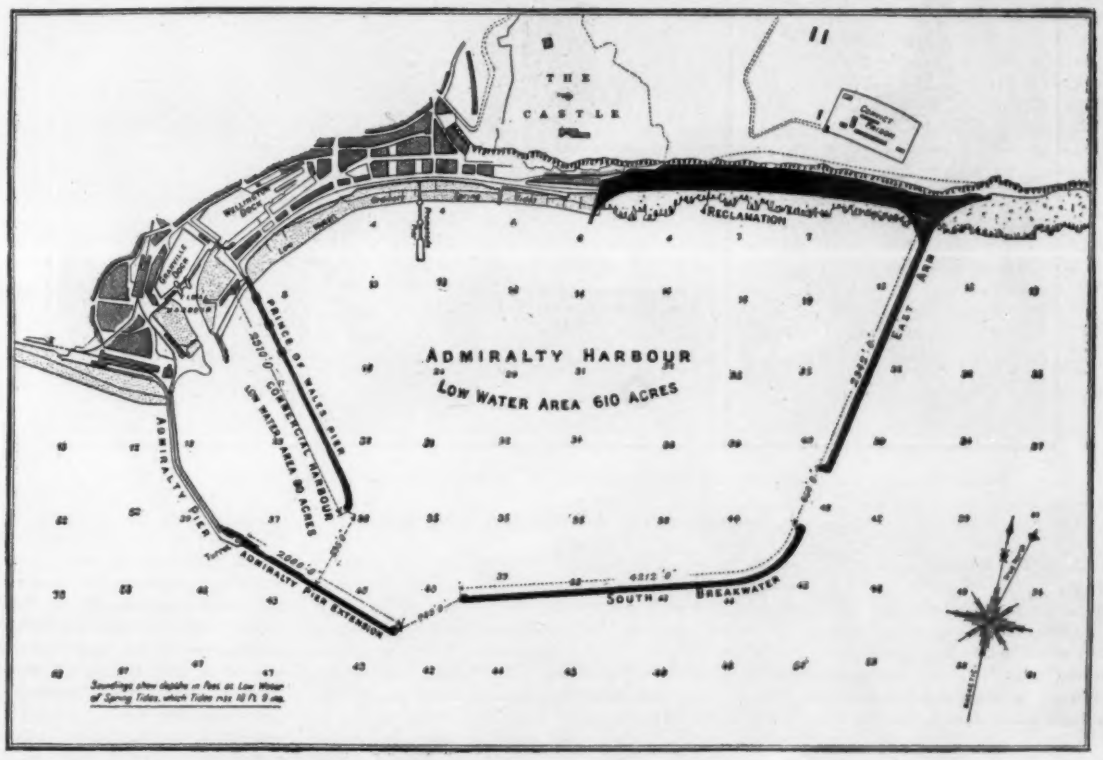
The surveys showed that the sea bed consisted of chalk, chalk marl, and flints, so that a solid foundation could be secured for the masonry work. The work is carried out in solid masonry, the blocks ranging from 26 to 40 tons in weight, and composed of 6 to 1 concrete. A large block-making yard was established as soon as possible upon the area reclaimed from the sea, and here two 45-ton gantry cranes for handling the blocks were erected. The material for the concrete was drawn from suitable points a few miles distant, and a funicular railway was built to the top of the cliff for bringing the material down to the electrically-operated Messent concrete mixers, which while the mixing operation was in progress traveled along an elevated track above the molds, and dumped their contents where and as required. In all, 260,000 tons of Portland cement was consumed in the preparation of 1,300,000 cubic yards of concrete.

Actual construction was carried out from elaborate heavy timber staging, the piles of which in some cases exceeded 100 feet in length. This staging was carried to a height of 46¼ feet above low water, and the deck was provided with tracks for the manipulation of the various constructional appliances. These latter comprised Goliath cranes ranging from 40 to 60 tons capacity and with a radius of 100 feet. Four of these cranes were used simultaneously on the stag-

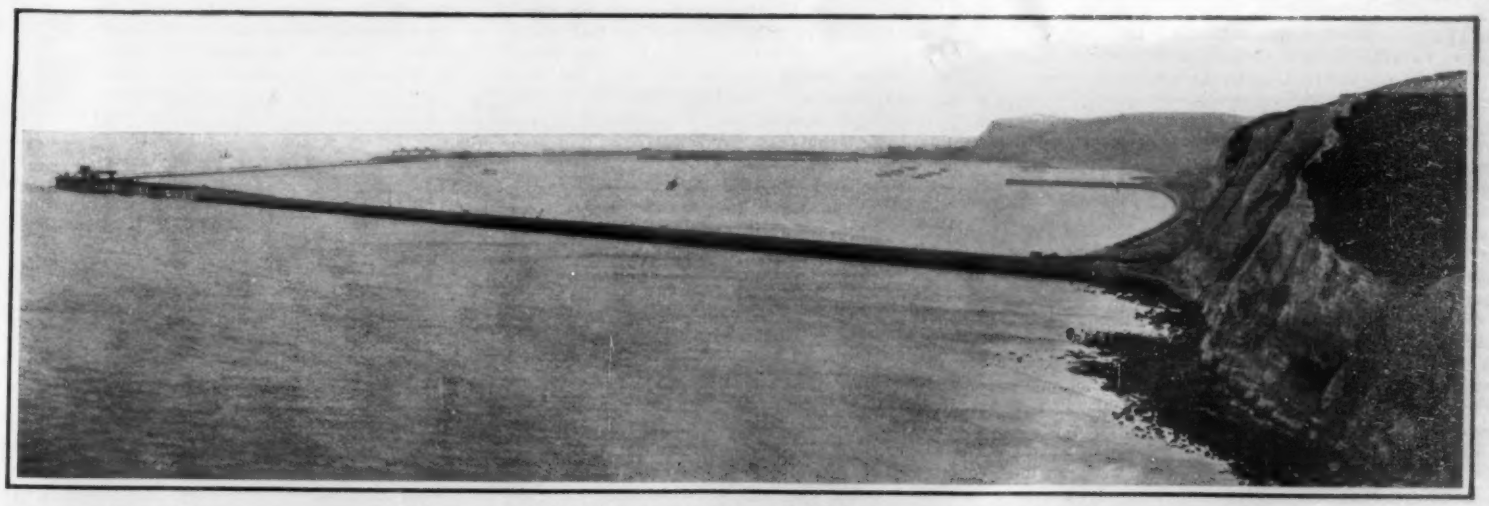


At extreme left, grab for clearing foundations; at right, diving bell ready to descend. At rear, cranes for setting blocks below the water level.

Staging at the pierhead works.



Plan of the Dover harbor works. New structure shown in full black.



Complete view of Dover Bay and Harbor.

THE NEW NAVAL HARBOR AT DOVER.

ing. The subaqueous work was accomplished by means of diving bells. Most of these had an internal measurement of 17½ feet by 10 feet and 6½ feet headroom, with a weight of 35 tons when out of water and about 5 tons when submerged. They were fitted with telephonic communication, and were provided with electric lighting. The sea bed was first cleared by means of the grab excavators to within about 12 inches of the requisite level. Then the diving bell descended, and the men within completed the work and excavated to about 3 feet below the level for the foundations of the superstructure. Owing to the severity of the scour and tidal action, the foot of the breakwater on its outer face is protected by a masonry apron about 25 feet in width, built up of concrete blocks ranging from 9 to 14 tons in weight, and 3 feet 6 inches deep. The bed for the apron was excavated to a depth of 2 feet by divers. From foundation level up to low water the blocks are bonded together by varying the length of the blocks, and are doweled in the vertical joints with 4 to 1 concrete sausage dowels of circular section. Above low water the courses are bedded and grouted in 2 to 1 cement mortar, while the outside blocks above this point are faced with granite, the stones being well bonded into the concrete matrix.

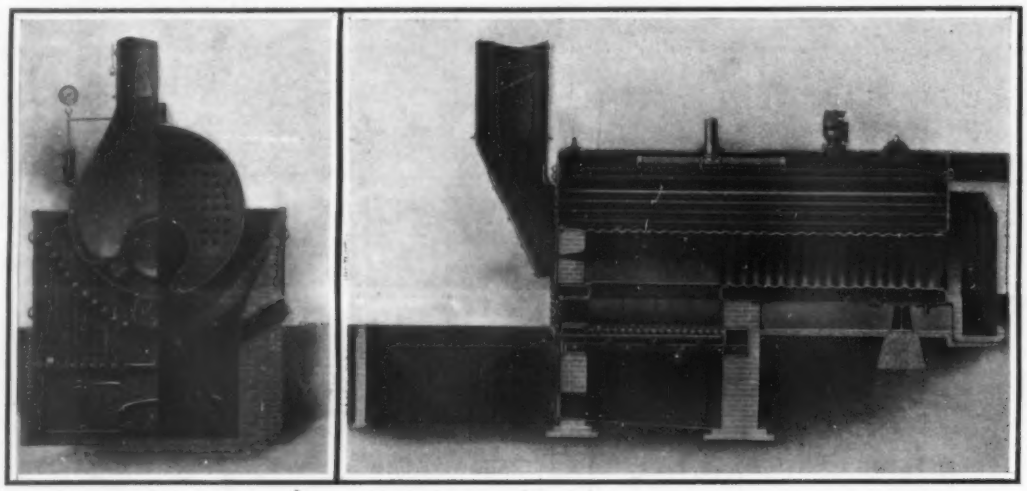
The reclaimed area lies at the foot of the cliffs, and has a length of 2,300 feet by a maximum width of 350 feet, the space being some 22 acres. On this expanse it is intended to erect the various buildings required for repairs, stores, and so forth, as well as two protected reservoirs for the storage of gasoline for submarines, a station and depot for which is to be established here. The eastern arm projects seaward from the eastern extremity of this reclaimed area in a southerly direction for 2,942 feet. The construction of this southern breakwater was among the most difficult of the whole undertaking, owing to its exposed position and the great depth of water. The average depth on this section of the foundations below low spring tides was about 47 feet, the greatest depth being 53 feet. Work was commenced in August, 1904, and by December of the same year, 430 feet of foundations was completed, and the masonry brought up to the level of low water. When the extension on the western pier had been completed, and the plant there used was transferred to the island section, work was maintained at a much higher pressure, 2,000 feet of foundations being completed in a year, while in two months alone 1,145 blocks were set in position.

The width of the structures at foundation level ranges between 52 and 57 feet. In the case of the eastern arm the width at deck level is 47½ feet, while that of the southern breakwater is 40 feet, and the Admiralty pier extension 45 feet. In all cases the height of the deck level above high water spring tides is the same, viz., 10 feet.

The extension of the existing Admiralty pier was commenced in August, 1899. This arm was to be doubled in length, that is, to 4,000 feet; and in this case, owing to the existence of a revolving gun turret on the old pier head, which it was decided to retain, the pier had to be widened for a distance of some 690 feet in order to permit the railroad tracks serving the steamship berths to be laid.

Both the western and eastern piers are provided with a parapet 11 feet and 10 feet wide respectively, the top of the former being 43¼ and that of the latter 39 feet above low water. The deck of the south breakwater, however, is quite level, though similar provision can here be made if and when desired.

The works have given employment to from 1,500 to 1,800 men; and considering its character, the accidents and fatalities have been insignificant. No deaths or permanent injuries were recorded in connection with working in compressed air, either in the diving bells or diving dresses. During construction several exciting incidents occurred. While the south breakwater was under construction, the liner "Deutschland" ran into it, seriously damaging its stem, and removing a mass of masonry. As a result several blocks had to be removed and reset. To carry out this work, an ingenious hydraulic ram was especially evolved, comprising a horizontal cylinder having vertical rams capable of exerting a lift of 150 tons, by means of which the blocks were lifted so as to be gripped by the Goliath cranes, and then reset. On another occasion a vessel while entering the harbor fouled the timber staging. The collision was so violent that the two outermost cranes were carried away, and considerable damage inflicted. Severe delays occurred through gales. In consequence of the exposed character of the position, the full force of the southwesterly and easterly storms was experienced, the waves sweeping over the works. Owing to the elaborate precautions adopted, however, no valuable plant was lost, though at times the heavy staging showed striking evidences of the battering by wind and wave. It may be mentioned that the quantity of water required during an ordinary spring tide, and which flows through the two entrances, is 17,000,000 tons.



Front elevation and longitudinal section, showing the curved grate and interior details of the boiler.

A NOVEL BOILER AND FURNACE CONSTRUCTION.

The furnace and boiler illustrated in the accompanying engravings possess many decidedly novel features which nevertheless have proved efficient in practice. The grate of the furnace is curved up at each side of the boiler so that the forward part of the boiler is half submerged in the fuel, which comes in direct contact with the boiler shell. The fire burns its way up through the coal, which as it is consumed feeds downward from opposite sides of the boiler, while there is a downward draft through the coal which carries the gases to the bottom of the furnace and here they combine with air that passes through admissions at each side of the ash pit and flows between the grate bars up through the incandescent fuel. The burning gases then flow through a narrow neck into a corrugated flue of large diameter which conducts them to the rear end of the boiler, after which they pass through the boiler tubes to the stack. Great care is taken to proportion the stack to the surface area of the tubes and flue so that the highly heated gases will pass slowly through the boiler and deliver the maximum number of heat units for the generation of steam. The side grates of the furnace are provided with rocking bars which may be operated individually, but they are preferably connected to a single shaft, as shown in the illustration, by which they may be operated all at once, either by hand or mechanically to shake the coal downward toward the bottom of the grate. The lowermost part of the grate is provided with a section which may be reciprocated lengthwise when shaking down the fire. Ordinarily, the fuel tends to feed itself down the side grates, and it is merely necessary to supply it with sufficient coal at the top. The fuel is thoroughly dried as it progresses downward so that there is little chance for the production of smoke despite the fact that the inner wall of the furnace consists of the water-cooled boiler shell. Most of the draft supplied to the furnace enters the side admissions of the ash pit, which are provided with dampers to regulate the in-take of air.

In the spring of 1907 one of these boilers was installed in a factory at Dover, N. J., to take the place of two boilers of 50 and 60 horse-power respectively. The new boiler on the usual rating of grate area to the tube and flue area should have generated about 74 horse-power, but under test it was found to develop 98.5 horse-power. Formerly a stack 120 feet high was required, but with a new boiler the stack was reduced to one extending but 25 feet above the boiler. The boiler was 6 feet in diameter and 11½ feet long, containing 84 3-inch tubes. The neck of the main flue was 9 inches wide and 56 inches long, while the flue was 27 inches in diameter.

This boiler has been in use constantly ever since, and we are informed that it is giving perfect satisfaction. The principal claims for it are that it requires less fuel and less attention than heretofore, while combustion is almost smokeless. Since the first installation at Dover a number of these boilers have been installed in this vicinity and appear to be doing good service.

A Novel Balloon Gas.

At the recent Congress of German Aeronauts at Frankfort on the Main, Dr. W. von Oechelhaeuser presented a preliminary communication on the results of experiments made in conjunction with the German Continental Gas Company toward the production of a new balloon gas. These show the decomposition of ordinary coal gas in vertical retorts to yield in normal operation a balloon gas of a specific weight of about 0.225, so that about one kilogramme would be the lifting power of one cubic meter. According to the Statutes and Regulations of the International Association of Aeronauts, the buoyancy of one cubic meter of street gas has so far been calculated at 0.700 kilogramme and that of hydrogen gas at 1.050 kilogramme. It is true that in connection with certain hydrogen plants a gas of a lifting power of 1.185 kilogramme is said to have been obtained, and that the official figure of 0.700 kilogramme would be too low for a number of gas works, corresponding to too great a specific gravity, viz. 0.44. During the Gordon Bennett ascents at Berlin, a gas of 0.4 specific weight was used. However, on the basis of the official international figures above stated, the lifting power of the new balloon gas would bear a ratio of 1,000/1,050 to the lifting power of hydrogen. This would mean that a balloon of a capacity of 1,000 cubic meters would be able to lift 300 kilogrammes more than a balloon of the same capacity filled with coal gas, or else the size of a balloon with the same lifting power could be reduced by 30 per cent.

This balloon gas contains upward of 80 per cent of hydrogen, while the content of methane, which was the most difficult to decompose, is reduced 5 to 7 per cent. The gas has only a very slight odor, which is likely to prove very convenient to passengers in the case of free balloons with open charging tubes. Furthermore, it contains neither benzol nor any other heavy hydrocarbon capable of attacking the balloon cover. The theoretical fact that coal gas is decomposed by great heat, which is underlying the process, has long been known, and seems to have been first discovered by Bunte about forty years ago. However, the difficulties so far experienced in utilizing this reaction for the production of a light gas on an industrial scale proved far greater than had been supposed. The most important point was to produce this gas during the ordinary operation of the gas works, and in the same retorts in which the ordinary coal gas is generated. The inventor therefore used the vertical retorts of the Dessau gas works. He is now engaged in experiments intended to ascertain whether the process is adaptable also to horizontal retorts and other types.

The Washington Aqueduct, after forty-six years of service, is in excellent condition, according to the last annual report of Major Jay J. Morrow, of the United States Corps of Engineers. This aqueduct crosses 26 valleys on 4 bridges and 22 embankments containing culverts. The only signs of deterioration were found, it is reported, in unlined portions of the conduit where a small quantity of rock had fallen from the roof and side walls. It was noted that the mortar in the brick masonry in the lined sections, although inferior to present-day Portland cement, had not been washed out of joints to any great extent. Recent experiments showed that 90,000,000 gallons per day is about the maximum carrying capacity of the aqueduct.

According to the Railroad Age Gazette, the Mexican Railway, which recently equipped thirty of its locomotives to burn oil, has been unable to get an adequate supply of this fuel, and has had eighteen engines reconverted into coal burners. The oil company which failed to carry out its contract, it is reported, bears the expense of the change.

CURIOSITIES OF SCIENCE AND INVENTION

NEW METHOD OF CARRYING AN UNCONSCIOUS PERSON.

A new method of carrying persons who are unconscious, injured, or otherwise incapacitated is being used by the New York Fire Department. Ordinarily the unconscious man is turned face downward and then lifted up on his knees, after which he is placed across the fireman's shoulder. The new method consists of throwing the burden across the back over both shoulders, instead of one as heretofore. The right thigh and right upper arm of the man that is being carried are gripped between the fireman's arms and body close to the armpits. This leaves the fireman's forearms and both legs free. Formerly the fireman had the use of but one hand and arm, making it a difficult matter to carry a victim down a scaling ladder. With the new method the weight of the burden is supported in a position where a maximum load can be carried with minimum exertion. The one that is rescued is firmly locked on the fireman's shoulders by the powerful muscles of the shoulders and upper arms. With both forearms and hands free the fireman can carry a burden down a vertical ladder without danger of falling and can even slide down the ladder after a little practice. To. Dr. Charles H. Duncan, whose work at one of the emergency hospitals of this city has brought him into contact with firemen and others injured at fires, the New York Fire Department is indebted for this new and practical method of carrying an unconscious person.

CARRYING THE MAN DOWN A SCALING LADDER.

LIFTING THE MAN ONTO THE BACK AND SHOULDERS.

EXPERT CHAIN WHITTLING.

For several years I have been collecting specimens of expert jackknife whittling. Among those who have contributed specimens is Mr. George W. Lockwood, Long Ridge, Conn. About two years ago he supplied some specimens of chain whittling from a "broomstick" that were far above the ordinary. For a time I regarded them as the best in existence. A little later I obtained some triple chains from a Philadelphia expert that slightly excelled those by Mr. Lockwood, whose attention was called to the Philadelphia work. Mr. Lockwood determined to "go him one better," and the results were the two chains and ornaments shown herewith. These are by far better than any others I have been able to obtain. Each chain is from a piece of wood of broomstick shape; the cutting is without break and done with an ordinary jackknife. The "nested" hourglass sections are especially intricate and skillfully done. The inner "glasses" turn readily in sets or sections. As will be readily seen, the links are symmetrically shaped and well finished.

"How long did it take you to make them?" I inquired.

"Time? Oh, don't mention it. I didn't dare keep any record!"—Edward F. Bigelow.

A VACUUM CLEANER FOR CLEANING STREETS.

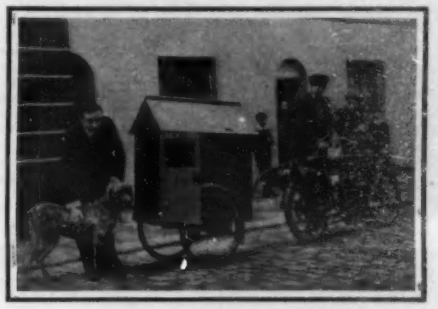
The war against dust which is now so successfully waged in houses by means of vacuum cleaning machines should undoubtedly be extended to include street cleaning. It is just as important to keep the dust down when sweeping streets, and more so because street dust is always heavily laden with disease germs which are a constant menace to passersby and particularly to the street sweepers. A machine has just been perfected which works somewhat on the principle of the smaller household vacuum cleaners. The dirt and refuse of the surface over which the machine travels is gathered by rotating brushes and then by pneumatic power is sucked or lifted into conduits, where the heavier parts of the refuse are extracted and deposited in closed receptacles. The fine dust which it has been impossible for mechanical sweepers as heretofore devised to dispose of is carried onward in closed conduits and wetted down so that it may be taken off in the form of silt.

The suction mechanism is operated by the engine which propels the machine, the power of the exhaust being utilized in the process of separating and reducing the dust.

By actual tests recently made under the most adverse conditions this sweeper has shown its ability to clean in an hour as much street surface as the old-fashioned horse-drawn sweeper will sweep or brush in six hours.

MOTOR AMBULANCE FOR DOGS.

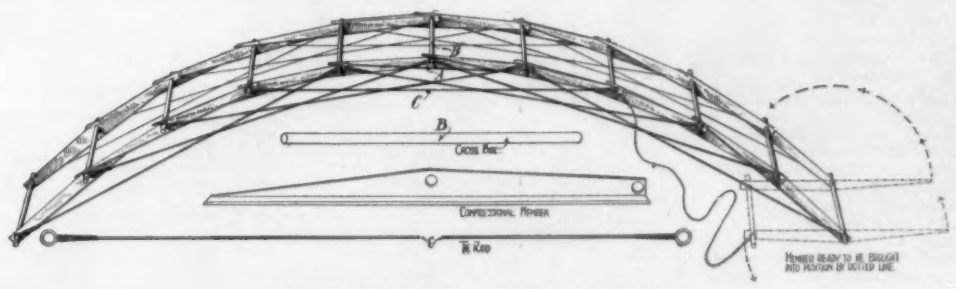
A curious motor ambulance for dogs is to be seen in the west end of London. This ambulance is the property of the Animals' Hospital, and is used for conveying dogs to and fro. It resembles a Noah's Ark in shape and is drawn by a 3-horse-power motorcycle, to which it is attached by means of an ingenious coupling device which prevents the ambulance overturning when traveling around corners. The ambulance is mounted on easy springs, is fitted with pneumatic tires, and is well padded inside in order to minimize vibration. Being motor drawn, it can do long journeys expeditiously, and ailing animals can be conveyed to the hospital and treated without delay.



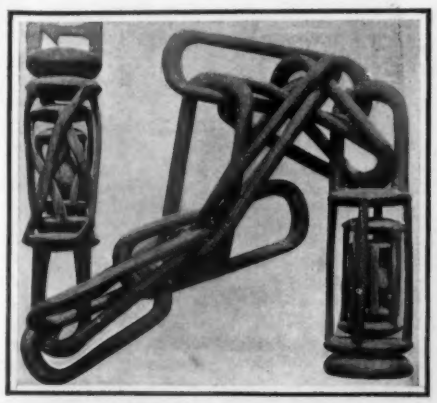
MOTOR AMBULANCE FOR DOGS.

A NOVEL BRIDGE CONSTRUCTION.

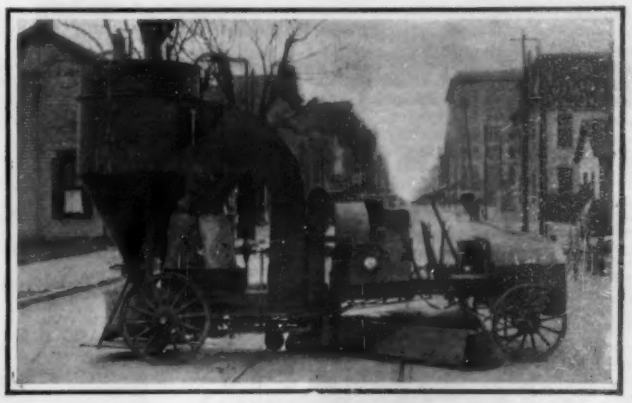
An emergency bridge construction which appears to have considerable merit was recently exhibited before the British War Office. It comprises only three different pieces, illustrated at *A*, *B*, and *C* in the accompanying sketch. The part *A* is the compressional member, and is the only part which would have to be carried in stock. Parts *B* could be chopped out of timber growing in the vicinity, while the tie rods *C* could be formed on the spot of rope or preferably wire. The construction of the bridge will be understood by referring to the members shown in dotted lines at the right-hand end of the bridge. A crossbar which runs through the last compressional members of the bridge serves as a pivot for two more compressional members that are centrally fulcrumed thereon. When the two compressional members are swung around, as indicated by the arrows, the tie rod is drawn taut and serves to take its share of the load. In building up a bridge of this sort, the outer end could be supported on a boat or pontoon while the engineers were adding the successive pairs of members to the shore end of the bridge, until a sufficient span was produced to reach across the stream. The construction was designed particularly for use in reinforcing a concrete arch. When used in this way, the compressional bars could be placed at the outside, and after the concrete had set they could be removed for use in building the next arch.



NOVEL TEMPORARY BRIDGE CONSTRUCTION.



SPECIMENS OF CHAIN WHITTLING. NOTE THE "NESTED HOURGLASSES."



VACUUM CLEANER FOR CLEANING STREETS.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

NECKTIE-FASTENER AND COLLAR-BUTTON.—T. Papworth, Portland, Ore. The object of the inventor is to provide a combined necktie retainer and collar button, which can be easily inserted in and removed from a stiffly-starched collar, and which in its preferred form effectually conceals the tie fastener. The retainer and button is preferably made of a single flat piece of metal, although it may be produced by other means.

Of Interest to Farmers.

BALING-PRESS.—I. W. Rohrer, Jr., Lancaster, Pa. This is a powerful and simple press for tobacco and like material. It can be easily manipulated by one operator and the material to be compressed can be rapidly and easily formed into compact bales which permits twine or the like to be positioned therein to facilitate the binding of the bales, and there are special locking means for holding the folding sides in position.

WIRE-STRETCHER.—J. B. Davis and F. S. Adams, Wisner, Neb. This stretcher is arranged to permit properly stretching wire between posts or around a corner post, and to hold the stretched wire until it is fastened in place, and without danger of causing any slack between the post and stretcher, and to allow of readily splicing adjacent wires without the stretcher being in the way of the operator making the splice.

SPRING-TOOTH CULTIVATOR.—G. G. Bateman, Cypress, Ala. This cultivator is of the type that presents cross-bars to which the spring teeth or hoes are attached. By adjusting the position of these bars the arrangement of the teeth can be changed as desired. The adjusting mechanism will insure that the bars will hold themselves perfectly rigid in their different adjusted positions.

Of General Interest.

COAL-BASKET.—H. G. Mitchell, New York, N. Y. The aim in this improvement is to produce a basket especially adapted to be formed of duck, canvas or similar stout fabric, and which is provided with a reinforcing frame giving the finished basket strength and durability for handling coal or the like. Feet project below the bottom of the frame to receive the principal part of the wear across the earth or floor.

ELECTRIC FURNACE FOR THE CONTINUOUS EXTRACTION OF ZINC FROM ITS ORES.—E. F. Côte and P. R. Pierron, 24 Rue Sully, Lyon, France. The object in this improvement in electric furnaces is to permit zinc ores, preferably poor blends, to be treated in a continuous manner for extracting the metal therefrom, and permitting the heating of crude blends without it being necessary to previously roast them in order to transform the sulfid into oxid.

STOPPERING FOR BOTTLES INTENDED TO CONTAIN VOLATILE LIQUIDS.—J. Benoud, 47 Rue Blanche, Paris, France. This device enables a capillary orifice of larger diameter and the capillary orifice employed for delivering ethyl chlorid in medical practice to be stoppered. It may be utilized for ethyl chlorid or other volatile products either mixed or not with medicinal substances or with perfumery essences.

AREA FINDING APPARATUS.—Arthur C. Freeman, Norfolk, Va. The invention comprises a flat steel plate that is magnetized, and a number of soft iron balls. The drawing upon which the area is outlined is played over the plate. The area outlined is then filled with the iron balls. The magnetized plate causes them to cling to the plate and to each other. The balls are then taken out and placed in a measuring frame, and the number of square inches occupied by the balls is ascertained.

EYE-SHADE.—J. A. Blackstock, Seattle, Wash. The object of this invention is to provide a shade which will effectually prevent light rays from reaching the eyes, and it is especially adapted for use by people desiring to sleep in the daytime, in order to obviate the necessity of darkening the room.

GASTROSCOPE.—M. Sussmann, Berlin, Germany. This gastroscope comprises a horizontal and a vertical part. The latter when flexible is easily introduced through a feed pipe into the stomach, after which it is straightened for the examination. This part can be turned through any angle. After examination the vertical part is turned into its flexible state, so that it can be easily drawn out.

Heating and Lighting.

ADJUSTABLE HANGER FOR LIGHTS.—H. J. Hinds, Hillyard, Wash. The purpose of the inventor is to provide novel details of construction for an adjustable hanger, that is particularly well adapted for the suspension of a lamp or the like from an overhead support, and enable the vertical adjustment of the light at a desired height.

Note.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Legal Notices

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Nut lock, Reinoehl & Weaver 946,154
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Oil burner, H. Duke 945,922
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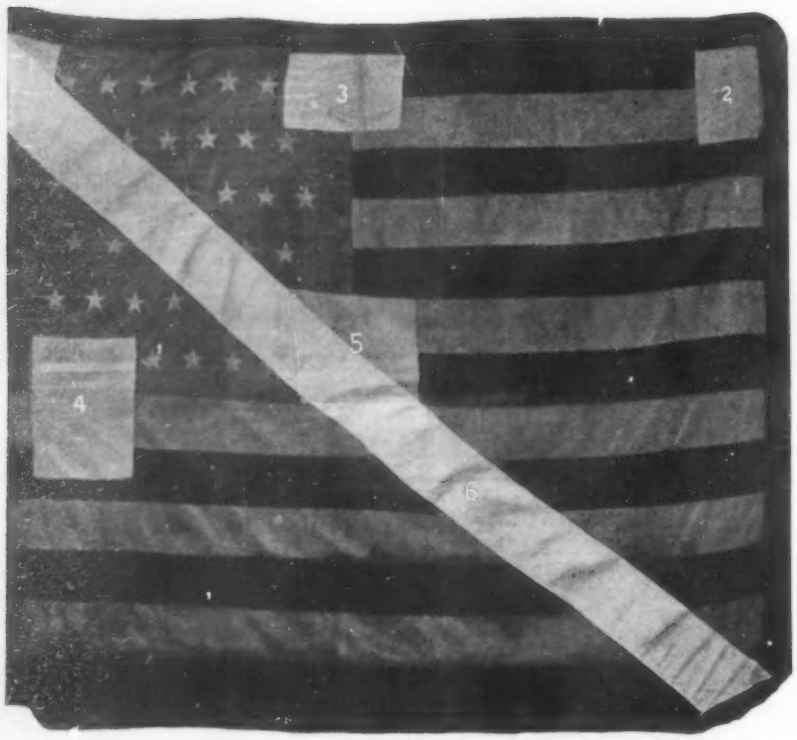
Toy, J. L. Clarke 946,013
Toy, figure, J. Y. Henry 946,042
Track sanding apparatus, L. A. Gibbs 946,346

(Concluded on page 95.)

This is the Flag Peary Nailed to the Pole



Pieces cut from its folds mark all the "farthest" northern points of the Western Hemisphere. 1 and 2 left at Cape Morris Jesup, 3 at Cape Thomas Hubbard, 4 at Cape Columbia, 5 at Peary's Farthest North 87° 6' – 1906, and 6 at the North Pole. Detailed fully in HAMPTON'S MAGAZINE for February

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Inquiry No. 9063.—Wanted to buy a machine that would wrap and tie up a loaf of bread.

Inquiry No. 9064.—For manufacturers of a cigarette making machine constructed as follows, a small metal box containing tobacco and papers, the cover contains a piece of cloth upon which is placed the paper and tobacco, the cover being closed the cigarette jumps forth.

Inquiry No. 9065.—Wanted to buy a second hand telephone generator,

Inquiry No. 9066.—Wanted complete outfit for export for making rice-flakes and wheat-flakes.

Inquiry No. 9067.—Wanted the address of makers of the Standard Folding Typewriter.

Inquiry No. 9068.—Wanted to buy machinery for manufacturing chewing gum, such as rolling, cutting or wrapping machinery.

(*Concluded from page 93.*)

Transom worker, P. R. Duchemin	946,020
Transportable elevator, B. F. Seymour	946,403
Trigger lock, R. A. Moore	945,852
Trolley wires, etc., catenary suspension for, G. A. Mead	945,972
Trolley wires of electric railways, supporting device for, K. von Kando	946,135
Truck, car, A. C. Vauciain	946,293
Truck, meat, C. A. Baker	946,095
Truck or running gear, vehicle, W. S. Willis	946,479
Truck, suspension railway, Butler & Rockman	945,750
Tube mill, J. S. Worth	946,303
Tubes and other articles, manufacturing composite, A. Boringer	946,325
Tubes, apparatus for making metal cased, Earle & Bourne	946,022
Turbine, A. Boeckel et al	945,742
Turbine, W. Robinson	945,807 to 945,811
Turbine driving auxiliary apparatus, A. H. Kruesi	945,962
Turbine, elastic fluid, C. G. Curtis	945,919
Turbine, elastic fluid, H. Geisenhoner	945,933
Type distributing apparatus, Johnson & Low	946,443
Type setting machine, H. M. Freck	945,777
Typewriter attachment, D. F. Maher	946,451
Typewriters, dead-key mechanism for, T. L. Knapp	946,229
Typewriting machine, A. F. W. J. von Wedel	945,829
Typewriting machine, O. Woodward	945,893
Typewriting machine, C. B. Yaw	945,895
Typewriting machine, H. W. Higham	945,951
Typewriting machine, H. N. Josleyn	945,956
Typewriting machine, H. I. Seddon	945,986
Typewriting machine, L. Sholes	945,987
Typewriting machine, J. Felbel	946,118
Typewriting machine, L. C. Myers	946,254
Typewriting machine, L. S. Hopley	946,365
Typewriting machine, tabulator, W. E. Mark	946,245
Typewriting stand, C. E. Goulding	946,218
Twine cutter, G. H. Colebeck	946,494
Umbrella, G. K. Garrett	946,121
Umbrella, G. K. Garrett	946,122
Umbrella, hat, or like support, E. C. Leonard	946,377
Undergarment, combination, L. M. Kugel	946,142
Universal joint, H. Quinby	945,803
Unloading apparatus, Snyder & Burt	946,282
Urinal, Baker & Gros Claude	945,837
Valve and faucet, F. W. Meyer	946,249
Valve and reverse gearing for steam engines, G. J. Clark	946,110
Valve, automatic spray, H. J. Richter	945,867
Valve bag, A. M. Bates	946,318
Valve, bellows, G. W. Bemis	945,905
Valve, electromagnetically operated, Gaudin & Tellier	946,344
Valve for irrigating systems, J. Lang	946,516
Valve for presses, automatic change, E. B. Anderson	946,481
Valve gear, H. S. Vincent	946,083
Valve, regulated automatic closing, J. L. Gish	946,217
Valve, steam engine, E. J. Armstrong	946,000
Vapor converters, means for starting serially operated, F. H. von Keller	946,053
Vegetable loader, E. E. Bergren	946,321
Vehicle brake, motor, H. M. Lyman	946,145
Vehicle wheel, B. P. Cooper	946,112
Velocipede, M. Slotkin	946,280
Ventilator. See Window ventilator.	
Vessels, device for locating sunken, Vroman & Hamilton	946,174
Veterinary impregnating instrument, C. W. Baird	945,739
Vibrator, A. J. Stecker	945,872
Voting machines, card holder for, E. Mattoon	946,062
Wagon, self loading, G. M. Forbess	946,028
Waiting stand for dining tables, B. F. MacMinn	945,848
Wall, reinforced partition, E. Flagg	946,211
Wardrobes, garment support for, Chandler & Goodyke	945,908
Warping machine, C. A. Steere	946,164
Washer. See Bolt washer.	
Washing machine attachment for stationary washtubs, W. Walton, Jr.	946,175
Washing machine cylinder, J. R. Golter	946,348
Washing machine operating mechanism, J. Edens	946,115
Watchcase bows, forming, Ulberg & Levy	946,082
Watch movement, W. B. Mehl	946,385
Water feed regulator, W. A. Kitts, Sr. & Jr.	946,139
Water gage, H. C. Burns	946,106
Water heater, A. E. & A. S. Higley	946,222
Water meter, self registering, F. W. Hanna	946,128
Water motor, A. Bratschie	945,746
Water, treating and storing, W. A. Powers	946,463
Wax, electrical apparatus for melting sealing, W. T. von Tillow	945,822
Waxing device, H. F. Haussmann	946,436
Weather strip, automatic or self adjustable, F. L. Barnick	946,482
Weeding and pruning implement, J. H. Blake	946,322
Weighing and bagging machine, automatic, J. B. Williams	946,184
Weighing machine, automatic, P. Edthaler	945,767
Weighing machine, tack, W. O. Taylor	946,171
Well rod lifter, C. J. Afleson	945,902
Wheel, T. H. Walbridge	945,824
Window, O. Baigne	946,491
Window alarm, A. D. Girard	945,935
Window attachment, J. A. Beckert	946,319
Window closing device, automatic, Magaw & MacVicar	946,244
Window cooling box, A. A. Svensen	946,474
Window operating mechanism, J. E. Ulsh	946,292
Window screen bracket, F. J. Warner	946,526
Window ventilator, J. O. Barker	946,097
Window ventilator, J. H. Franke	946,213
Windows and window screens, fastener for storm, J. Michaelson	946,250
Wire fabric, C. H. Gall	946,120
Wood molding machine, F. D. Green	946,507
Woodworking machine, F. D. Green	946,508
Wrench, Marks & Lueckert	946,383
Wrench, J. F. Crowl	946,498
Writing machine, E. B. Hess	946,359
Yarn tension device, chain, D. Lowe	946,370
Yoke fastener, neck, A. P. Hoard	945,783

A printed copy of the specification and drawing of any patent in the foregoing list, or any patent in print issued since 1863, will be furnished from this office for 10 cents, provided the name and number of the patent desired and the date be given. Address Munn & Co., Inc., 361 Broadway, New York.

Canadian patents may now be obtained by the inventors for any of the inventions named in the foregoing list. For terms and further particulars address Munn & Co., Inc., 361 Broadway, New York.